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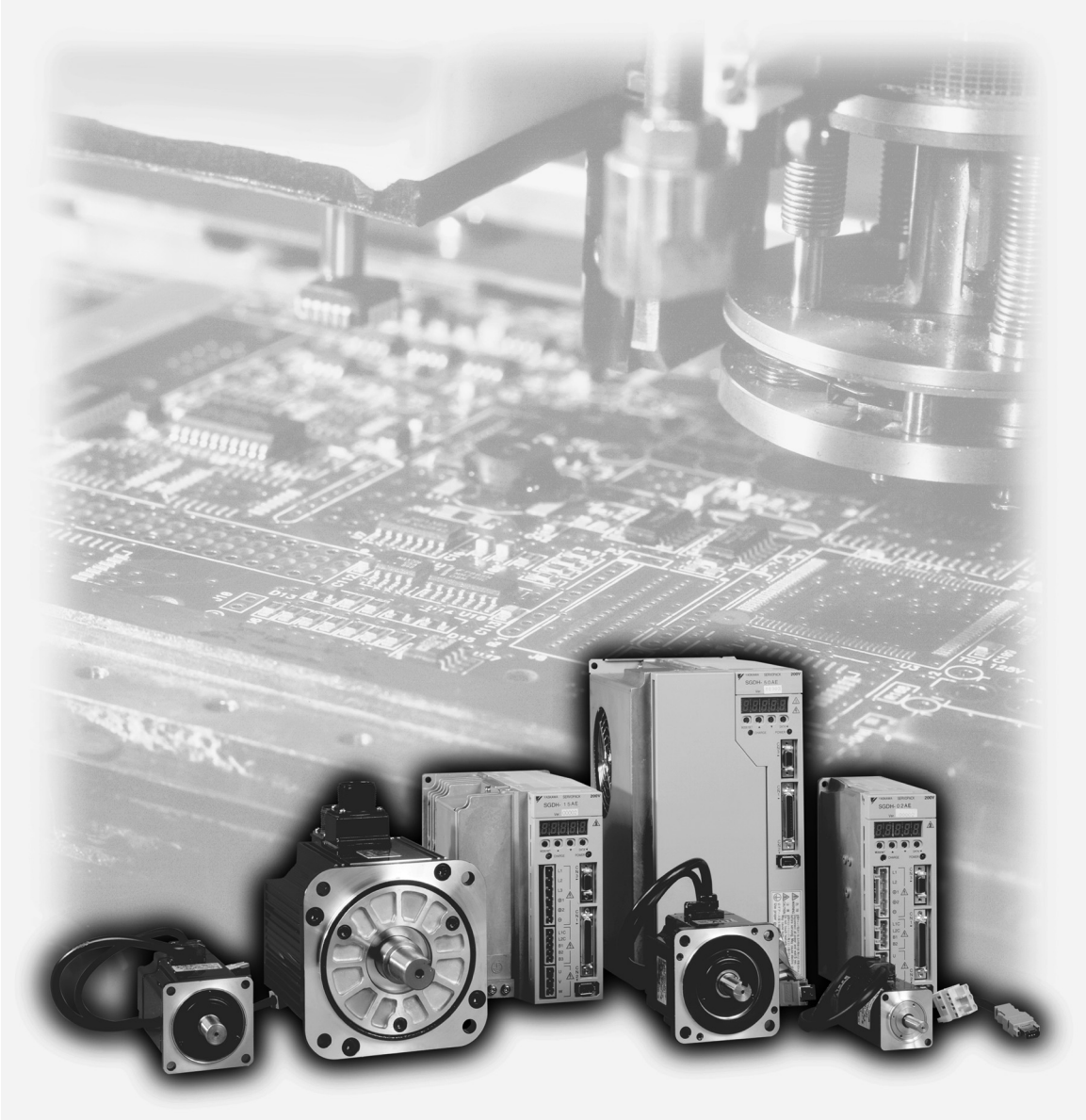

Sigma II Series Servo System User's Manual

⚠ WARNING

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Under no circumstances should any YASKAWA product be incorporated into any product or design as the exclusive or sole safety control. Without exception, all controls should be designed to detect faults dynamically and fail safely under all circumstances. All products designed to incorporate a component part manufactured by YASKAWA must be supplied to the end user with appropriate warnings and instructions as to that part's safe use and operation. Any warnings provided by YASKAWA must be promptly provided to the end user.

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⚠ WARNING

- **WARNING:** Indicates a potentially hazardous situation, which, if not heeded, could result in death or serious injury.

⚠ CAUTION

- **CAUTION:** Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury.

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Safety Precautions

The following precautions are for checking products upon delivery, installation, wiring, operation, maintenance and inspections.

■ Checking Products upon Delivery

⚠ CAUTION

- **Always use the servomotor and servo amplifier in one of the specified combinations.**
  Not doing so may cause fire or malfunction.

■ Installation

⚠ CAUTION

- **Never use the products in an environment subject to water, corrosive gases, inflammable gases, or combustibles.**
  Doing so may result in electric shock or fire.

■ Wiring

⚠ WARNING

- **Connect the ground terminal to a class 3 ground (100Ω or less).**
  Improper grounding may result in electric shock or fire.
- Required for 7.5kW amplifiers:
  Use of Yaskawa kit Number JZSP-CKT75 for wiring the power input and output terminals, or equivalent UL listed closed-loop ring terminals designed to accept 4 AWG wires.
- Required for 200V, 11kW and 15kW amplifiers:
  Use of Yaskawa kit number JZSP-CKT75 for wiring the power input and output terminals of the SGDH-1AAE, and JZSP-CKT1E for the SGDH-1EAE, or equivalent UL listed closed-loop ring terminal to accept 4 AWG and 2 AWG wires respectively.
- Required for 400V, 6.0kW and 7.5kW amplifiers:
  Use of Yaskawa kit Number JZSP-CKT75DE for wiring the power input and output terminals, or equivalent UL listed closed-loop ring terminals designed to accept 8 AWG wires.
- Required for 400V, 11kW amplifiers:
  Use of Yaskawa kit Number JZSP-CKT1ADE for wiring the power input and output terminals, or equivalent UL listed closed-loop ring terminals designed to accept 8 AWG wires.
- Required for 400V, 15kW amplifiers:
  Use of Yaskawa kit Number JZSP-CKT1EDE for wiring the power input and output terminals, or equivalent UL listed closed-loop ring terminals designed to accept 6 AWG wires.

CAUTION

- **Do not connect a three-phase power supply to the U, V, or W output terminals.**
  Doing so may result in injury or fire.
- **Securely fasten the power supply terminal screws and motor output terminal screws.**
  Not doing so may result in fire.

■ Operation

CAUTION

- **Never touch any rotating motor parts while the motor is running.**
  Doing so may result in injury.

CAUTION

- **Conduct trial operation on the servomotor alone with the motor shaft disconnected from machine to avoid any unexpected accidents.**
  Not doing so may result in injury.
- **Before starting operation with a machine connected, change the settings to match the parameters of the machine.**
  Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- **Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.**
  Not doing so may result in injury.
- **Do not touch the heat sinks during operation.**
  Not doing so may result in burns due to high temperatures.

■ Maintenance and Inspection

⚠ WARNING

- **Do not remove the panel cover while the power is ON.**
  Doing so carries a risk of electric shock.
- **Do not touch terminals for five minutes after the power has been turned OFF.**
  Residual voltage may cause electric shock.
- Never touch the inside of the servo amplifier.
  Doing so may result in electric shock.

⚠ CAUTION

- **Do not disassemble the servomotor.**
  Doing so may result in electric shock or injury
- **Do not attempt to change wiring while the power is ON.**
  Doing so may result in electric shock or injury

■ General Precautions

Note the following to ensure safe application:

- The drawings presented in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- This manual is subject to change due to product improvement, specification modification, and manual improvement. When this manual is revised, the manual code is updated and the new manual is published as a next edition. The edition number appears on the front and back covers.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.
- Yaskawa will not take responsibility for the results of unauthorized modifications of this product. Yaskawa shall not be liable for any damages or troubles resulting from unauthorized modification.

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1 Checking Product and Part Names

This chapter describes the procedure for checking products upon delivery as well as names for product parts.

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1.1 Checking the Sigma II Series Products on Delivery

The following procedure is suggested to check Sigma II series products upon delivery.

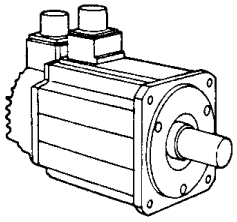
Use the following checklist when Sigma II series products are delivered.

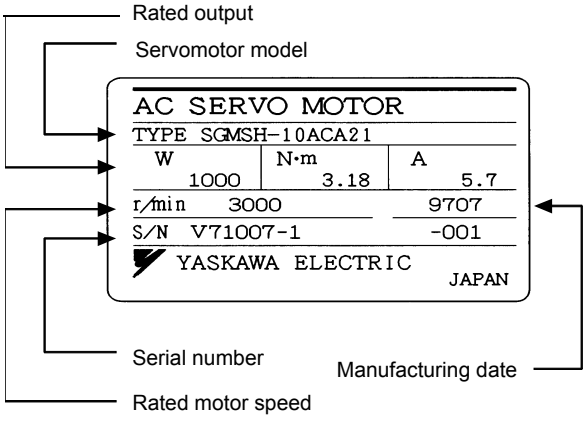
Initial Inspection	Comments
Are the delivered products the ones that were ordered?	Check the model numbers marked on the nameplates of the servomotor and servo amplifier. (Refer to the descriptions of model numbers on following pages)
Does the servomotor shaft rotate smoothly?	The servomotor shaft is normal if it can be turned smoothly by hand. Servomotors with brakes, however, cannot be turned manually.
Is there any damage?	Check the overall appearance, and check for damage or scratches that may have occurred during shipping.
Are there any loose screws?	Check screws for looseness using a screwdriver.

If any of the above are faulty or incorrect, contact Yaskawa or an authorized distributor.

1.1.1 Servomotors

■ External Appearance and Nameplate Example





■ Model Numbers

Standard Servomotors

SGMPH - 01 A A A 2 S

Sigma II Series Servomotor Name
SGMAH
SGMPH
SGMGH
SGMSH
SGMUH
SGMBH

Servomotor Capacity (See Table 1.1)

Power Supply
A: 200V
B: 100V*
D: 400V

*The only 100V servomotors are the 0.2kW or less SGMAH and SGMPH models.

Serial Encoder Specifications (See Table 1.2)

Design Revision Order
A SGMAH
SGMPH
SGMGH (1500rpm)
SGMSH
SGMUH
E: SGMPH (IP67 waterproof specification)
SGMBH : A = 200% Peak Torque
B = 250% Peak Torque

Shaft End Specifications
((See Table 1.3))

Brake and Oil Seal Specifications
1: Standard
S: With oil seal
C: With 24V_{DC} brake
E: S + C
SGMBH: See Catalog for options.

Table 1.1: Servomotor Capacity (kW)

Symbol	SGMAH	SGMPH	SGMGH	SGMSH	SGMUH	SGBMH	Symbol	SGMAH	SGMPH	SGMGH	SGMSH	SGMUH	SGMBH
	3000rpm	3000rpm	1500rpm	3000rpm	6000rpm	1500rpm		3000rpm	3000rpm	1500rpm	3000rpm	6000rpm	1500rpm
A3	0.03	—	—	—	—	—	40	—	—	—	4.0	4.0	—
A5	0.05	—	—	—	—	—	44	—	—	4.4	—	—	—
01	0.1	0.1	—	—	—	—	50	—	—	—	5.0	—	—
02	0.2	0.2	—	—	—	—	55	—	—	5.5	—	—	—
04	0.4	0.4	—	—	—	—	75	—	—	7.5	—	—	—
05	—	—	0.45	—	—	—	1A	—	—	11	—	—	—
08	0.75	0.75	—	—	—	—	1E	—	—	15	—	—	—
09	—	—	0.85	—	—	—	2B	—	—	—	—	—	22
10	—	—	—	1.0	1.0	—	3Z	—	—	—	—	—	30
13	—	—	1.3	—	—	—	3G	—	—	—	—	—	37
15	—	1.5	—	1.5	1.5	—	4E	—	—	—	—	—	45
20	—	—	1.8	2.0	—	—	5E	—	—	—	—	—	55
30	—	—	2.9	3.0	3.0	—							

Table 1.2: Serial Encoders

Code	Specification	SGMAH	SGMPH	SGMGH	SGMSH	SGMUH
1	16-bit absolute encoder	Standard	Standard	—	—	—
2	17-bit absolute encoder	—	—	Standard	Standard	Standard
A	13-bit incremental encoder	Standard	Standard	—	—	—
B	16-bit incremental encoder	Optional	Optional	—	—	—
C	17-bit incremental encoder	—	—	Standard	Standard	Standard

Table 1.3: Shaft End Specifications (Straight)

Code	Specification	SGMAH	SGMPH	SGMGH	SGMSH	SGMUH	SGMBH
2	Straight without key	Optional	Optional	Optional	Optional	Optional	—
4	Straight with key	Standard	Standard	—	—	—	Standard
6	Straight with key and tap	Optional	Optional	Standard	Standard	Standard	Optional
8	Straight with tap	Optional	Optional	Optional	—	—	—
K	Straight without key, foot mounted	—	—	—	—	—	Optional
L	Straight with key & tap, foot mounted	—	—	—	—	—	Optional (55kW Standard)

1.1.2 Direct-drive Motor Supporting Function

■ Applicable Motors

This function is applicable to the following SGMCS servomotors.

Servomotor Type
SGMCS- ☐☐ C
SGMCS- ☐☐ D
SGMCS- ☐☐ B
SGMCS- ☐☐ E
SGMCS- ☐☐ M
SGMCS- ☐☐ N

Note: For direct-drive motors, ☐☐ indicates the motor rated torque. For other motors, ☐☐ indicates the motor capacity.

The direct-drive motor model can be confirmed by the auxiliary function Fn011"Motor models display" on the digital operator or the panel operator.

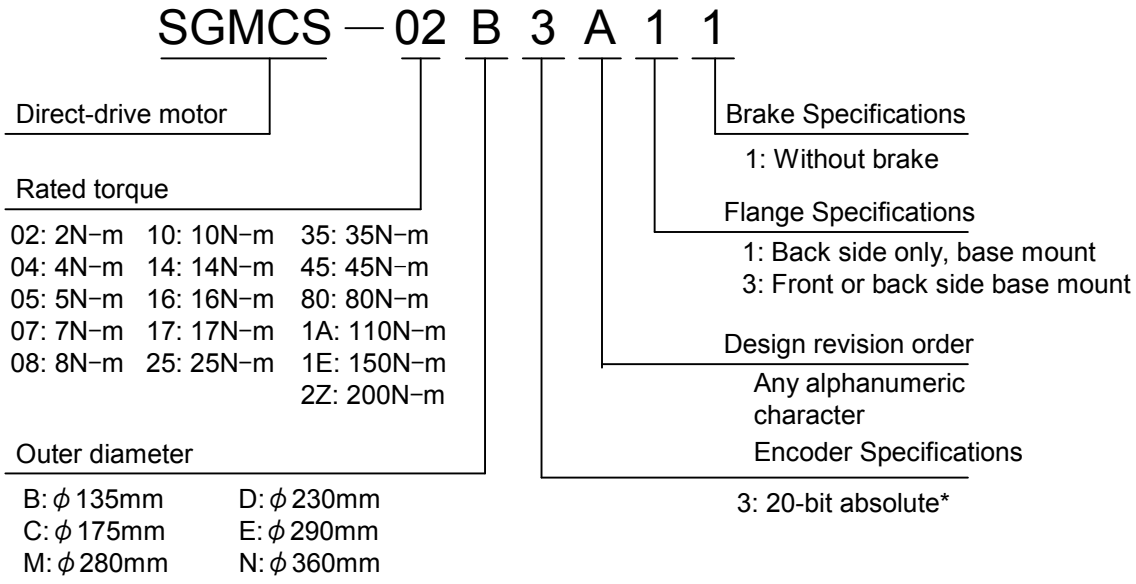
Fn011-F. ☐☐■■ "Voltage and Motor Model Display"

☐☐: Voltage
- 00: 100 VAC or 140 VDC
- 01: 200 VAC or 280 VDC
- 02: Reserved

■■: Motor model
- 00: SGMAH
- 01: SGMPH
- 02: SGMSH
- 03: SGMGH-☐A (1500 rpm)
- 04: SGMGH-☐B (2000 rpm)
- 05: SGMDH
- 32: SGMCS-☐☐C
- 33: SGMCS-☐☐D
- 34: SGMCS-☐☐B
- 35: SGMCS-☐☐E
- 37: SGMCS-☐☐M
- 38: SGMCS-☐☐N

Note: Note: 32 to 38 are direct-drive motors.

Model Designation

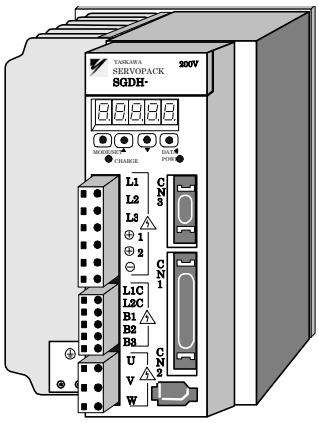

SGMCS — 02 B 3 A 1 1
Direct-drive motor
Rated torque
02: 2N−m 10: 10N−m 35: 35N−m
04: 4N−m 14: 14N−m 45: 45N−m
05: 5N−m 16: 16N−m 80: 80N−m
07: 7N−m 17: 17N−m 1A: 110N−m
08: 8N−m 25: 25N−m 1E: 150N−m
2Z: 200N−m
Outer diameter
B: φ135mm D: φ230mm
C: φ175mm E: φ290mm
M: φ280mm N: φ360mm
Encoder Specifications
3: 20-bit absolute*
Design revision order
Any alphanumeric character
Flange Specifications
1: Back side only, base mount
3: Front or back side base mount
Brake Specifications
1: Without brake

*Note: A single-turn data absolute encoder is mounted on SGMCS servomotors as standard. This may also be used as an incremental encoder.

For the details of single-turn data absolute encoders, see *5.11.2 Adaptation to Single-turn Data Absolute Encoder.*

1.1.3 Servo Amplifiers

■ External Appearance and Nameplate Examples



Sigma II series SGDH servo amplifier

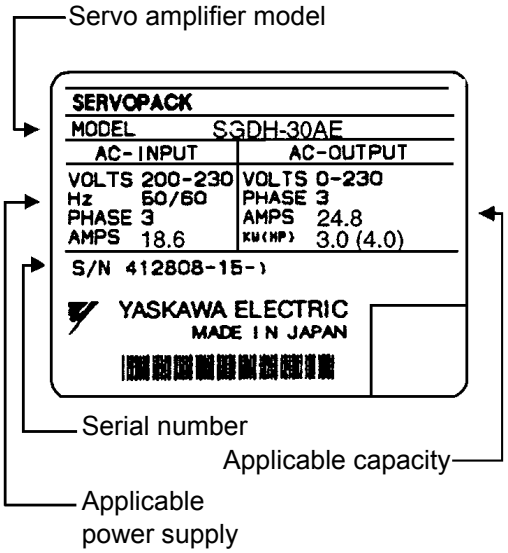


Table 1.4: Maximum Applicable Servomotor Capacity

Maximum Applicable Servomotor Capacity			
Symbol	Capacity (kW)	Symbol	Capacity (kW)
A3	0.03	50	5.0
A5	0.05	60	6.0
01	0.10	75	7.5
02	0.20	1A	11.0
04	0.40	1E	15.0
05	0.50	2B	22.0
08	0.75	3Z	30.0
10	1.0	3G	37.0
15	1.5	4E	45.0
20	2.0	5E	55.0
30	3.0		

■ Model Numbers

SGD□ - 10 A E - □

Sigma II Series
SGDH, SGDM Servo Amplifier

Maximum Applicable Servomotor Capacity
(See Table 1.4)

Supply Voltage
A: 200V (Single-phase/3-phase)
B: 100V* (Single-phase, 200W or less)
D: 400V
*The only 100V servomotors are the 0.2kW or less SGMAH and SGMPH

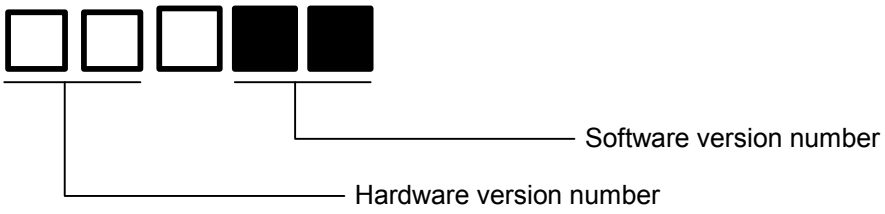
Type
D: For torque, speed, and position control (SGDM)
E: For torque, speed, and position control (SGDH)

Options/Design Sequence
A: Design Sequence "A" (SGDM only)
R: Rack mounted
S: Single-Phase
P: Duct-Ventilated (6 to 15kW only)

■ Amplifier Version Number

Check the 5-digit version number indicated on the front side of the servo amplifer. The first two digits indicate the hardware version, and the last two digits indicate the software version. Hardware version numbers higher than 33 and/or software version numbers higher than 32 signify upgraded products.

【 Servo Amplifer Version Number 】

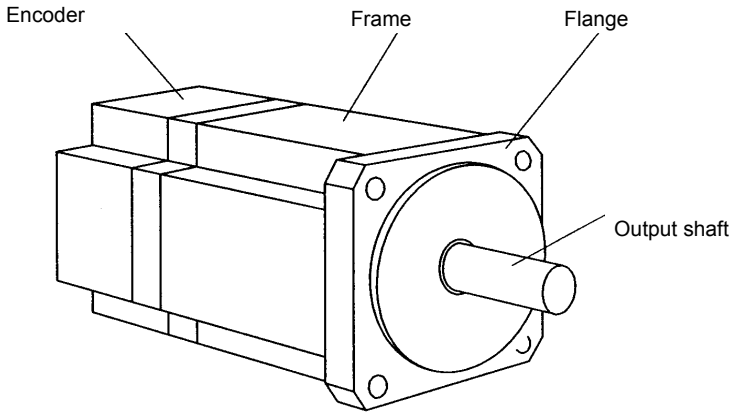


1.2 Product Part Names

This section describes product part names.

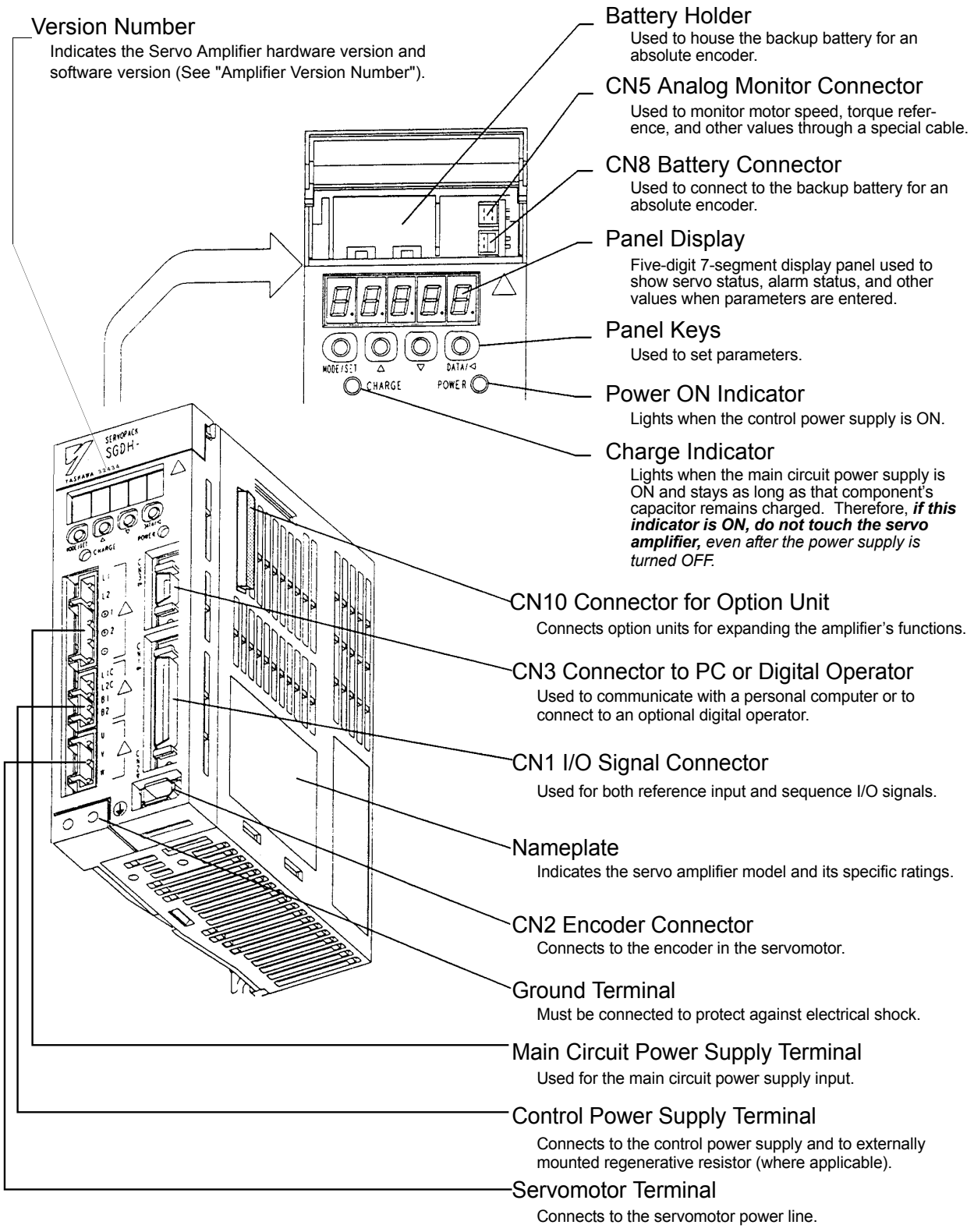
1.2.1 Servomotors

The figure below shows part names for servomotors with or without brakes.



1.2.2 Servo Amplifiers

The figure below shows the part names for servo amplifiers.


Version Number
Indicates the Servo Amplifier hardware version and software version (See "Amplifier Version Number").
Battery Holder
Used to house the backup battery for an absolute encoder.
CN5 Analog Monitor Connector
Used to monitor motor speed, torque reference, and other values through a special cable.
CN8 Battery Connector
Used to connect to the backup battery for an absolute encoder.
Panel Display
Five-digit 7-segment display panel used to show servo status, alarm status, and other values when parameters are entered.
Panel Keys
Used to set parameters.
Power ON Indicator
Lights when the control power supply is ON.
Charge Indicator
Lights when the main circuit power supply is ON and stays as long as that component's capacitor remains charged. Therefore, ***if this indicator is ON, do not touch the servo amplifier,*** *even after the power supply is turned OFF.*
CN10 Connector for Option Unit
Connects option units for expanding the amplifier's functions.
CN3 Connector to PC or Digital Operator
Used to communicate with a personal computer or to connect to an optional digital operator.
CN1 I/O Signal Connector
Used for both reference input and sequence I/O signals.
Nameplate
Indicates the servo amplifier model and its specific ratings.
CN2 Encoder Connector
Connects to the encoder in the servomotor.
Ground Terminal
Must be connected to protect against electrical shock.
Main Circuit Power Supply Terminal
Used for the main circuit power supply input.
Control Power Supply Terminal
Connects to the control power supply and to externally mounted regenerative resistor (where applicable).
Servomotor Terminal
Connects to the servomotor power line.
MODE/SET
DATA/
CHARGE
POWER

■ Additional References

Refer to the following manuals for information not included in this manual.

Manual Name	Manual Number
Sigma-II Series Servo System Product Catalog Supplement	G–MI#99001
Motion Products CD	YEA–CD–MTN–1
Sigma-II Series SGDH User's Manual Supplement for Linear Sigma Series	YEA–SIA–S800–39.21
SGMCS Direct Drive Sigma Series Servo Product Catalog	YEA–KAA–DDM–1

2 Installation

This chapter describes precautions for Sigma II Series servomotor and servo amplifier installation.

2.1 Servomotors 2-2
2.1.1 Storage Temperature 2-2
2.1.2 Installation Site 2-2
2.1.3 Alignment 2-3
2.1.4 Orientation 2-3
2.1.5 Allowable Shaft Loads 2-4
2.1.6 Vibration Resistance 2-5
2.1.7 Vibration Class 2-6
2.1.8 Handling Oil and Water 2-6
2.1.9 Cable Stress 2-6
2.2 Servo Amplifiers 2-7
2.2.1 Storage Conditions 2-7
2.2.2 Installation Site 2-7
2.2.3 Orientation 2-8
2.2.4 Installation 2-9

2.1 Servomotors

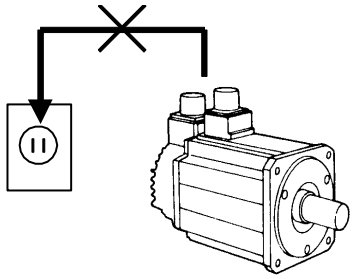
SGM□H servomotors can be installed either horizontally or vertically.

The service life of the servomotor can be shortened or unexpected problems might occur if it is installed incorrectly or in an inappropriate location. Follow these installation instructions carefully.

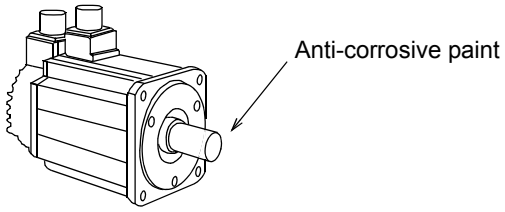
⚠ CAUTION

- **Do not connect the servomotor directly to a commercial power line. This will damage the servomotor.**

  The servomotor cannot operate without the proper servo amplifier.



Note: Prior to Installation:The end of the motor shaft is coated with anti-corrosive paint. Before installing, carefully remove all of the paint using a cloth moistened with paint thinner. Avoid getting thinner on other parts of the servomotor.



2.1.1 Storage Temperature

Store the servomotor within the following temperature range as long as it is stored with the power cable disconnected.

-20 to 60°C

2.1.2 Installation Site

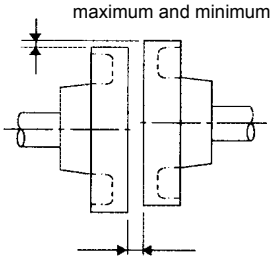
SGM□H servomotors are designed for indoor use. Install the servomotor in environments that satisfy the following conditions.

- Free of corrosive or explosive gases.
- Well-ventilated and free of dust and moisture.
- Ambient temperature of 0° to 40°C.

- Relative humidity (r.h.) of 20 to 80% with no condensation.
- Accessible for inspection and cleaning.

2.1.3 Alignment

Align the shaft of the servomotor with the shaft of the equipment, and then couple the shafts. Install the servomotor so that alignment accuracy falls within the following range.


Measure this distance at four different positions on the circumference. The difference between the maximum and minimum measurements must be 0.0012in (0.03mm) or less. (Rotate with the shafts coupled).
Measure this distance at four different positions on the circumference. The difference between the maximum and minimum measurements must be 0.0012in (0.03mm) or less. (Rotate with the shafts coupled).

Note:

- Vibration, which will damage the bearings, will occur if the shafts are not properly aligned.
- When installing the coupling, prevent direct impact to the shaft. This can damage the encoder mounted on the opposite end.

2.1.4 Orientation

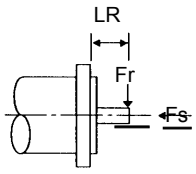
SGM□H servomotors can be installed either horizontally or vertically.

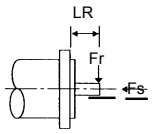
2.1.5 Allowable Shaft Loads

Design the mechanical system so thrust and radial loads applied to the servomotor shaft end during operation fall within the ranges shown in *Table 2.1*.

Allowable radial load in the table is the maximum load allowed on the end of the output shaft.

Table 2.1: Allowable Radial and Thrust Loads for the Servomotor

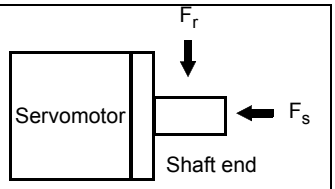
Servomotor	MODEL	Allowable Radial Load F_r Lb_f (N)	Allowable Thrust Load F_s Lb_f (N)	LR in (mm)	Reference Diagram
SGMAH	A3	15.29 (68)	12.14 (54)	0.79 (20)	
	A5				
	01	17.54 (78)			
	02	55.1 (245)	16.63 (74)	0.98 (25)	
	04				
	08	88.1 (392)	33.0 (147)	1.39 (35)	
SGMPH	01	17.54 (78)	11.02 (49)	0.79 (20)	
	02	55.1 (245)	15.29 (68)	0.98 (25)	
	04				
	08	88.1 (392)	33.0 (147)	1.39 (35)	
	15	110 (490)			
SGMGH	05A□A		22.0 (98)	2.28 (58)	
	05D□A				
	09A□A				
	09D□A				
	13A□A	154 (686)	77.1 (343)		
	13D□A				
	20A□A	264.3 (1176)	110 (490)	3.11 (79)	
	20D□A				
	30A□A	330.4 (1470)			
	30D□A				
	44A□A				
	44D□A				
	55A□A	396.5 (1764)	132 (588)	4.45 (113)	
	55D□A				
	75A□A				
	75D□A				
	1AA□A				
	1AD□A				
	1EA□A			(116)	
	1ED□A				
SGMSH	10A	154 (686)	44.1 (196)	1.77 (45)	
	10D				
	15A				
	15D				
	20A				
	20D				
	30A	220 (980)	88.1 (392)	2.48 (63)	
	30D				
	40A	264.3 (1176)			
	50A				
SGMUH	10D	110 (490)	22.0 (98)	1.77 (45)	
	15D				
	30D	154 (686)	44.1 (196)	2.36 (60)	

Servomotor	MODEL	Allowable Radial Load F_r Lb_f (N)	Allowable Thrust Load F_s Lb_f (N)	LR in (mm)	Reference Diagram
SGMBH	2B	5880 (1322)	2156 (485)	100 (3.94)	
	3Z	6272 (1410)	2156 (485)	100 (3.94)	
	3G	7448 (1675)	2156 (485)	100 (3.94)	
	4EA	7840 (1763)	2156 (485)	100 (3.94)	
	5EA	8428 (1895)	2156 (485)	100 (3.94)	

Note: Thrust and radial loads:

Thrust load (F_S): Shaft-end load applied parallel to the centerline of the shaft.

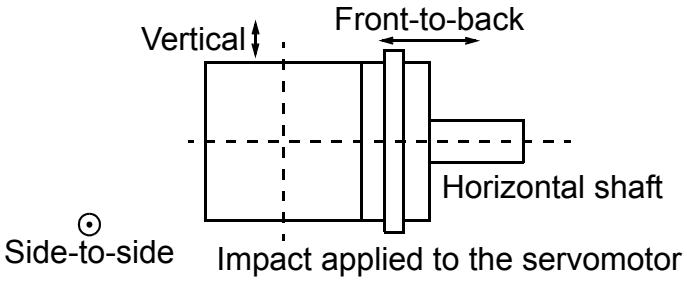
Radial load (F_r): Shaft-end load applied perpendicular to the centerline of the shaft.



2.1.6 Vibration Resistance

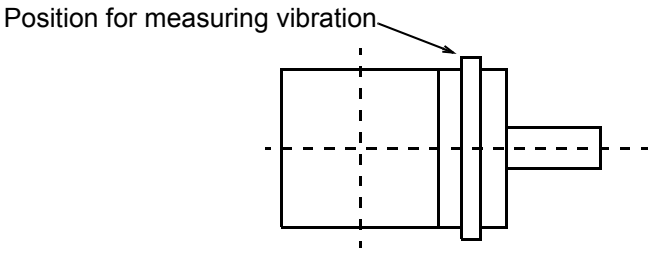
Mount the servomotor with the shaft positioned horizontally. The servomotor will withstand the following levels of vibration on all three axes: front-to-back (X), vertical (Y), and side-to-side (Z).

- SGMAH, SGMPH: 49m/s^2 (5G)
- SGMSH, SGMGH, SGMDH, SGMUH, and SGMBH: 24.5m/s^2 (2.5G)



2.1.7 Vibration Class

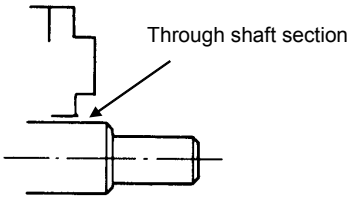
The vibration class for SGM□H servomotors operating at rated speed is 15μm (maximum).



2.1.8 Handling Oil and Water

Install a protective cover over the servomotor if it is used in a location that is subject to water or oil mist. Also use a servomotor with an oil seal when needed to seal the through-shaft section.

Install the servomotor with the connector facing down.



Note: Through sections of the shaft: This refers to the gap where the shaft protrudes from the end of the motor

2.1.9 Cable Stress

Make sure that the power lines are free from bends and tension.

Be especially careful to wire signal line cables so that they are not subject to stress because the core wires are very thin, measuring only 0.0079 to 0.012in (0.2 to 0.3mm).

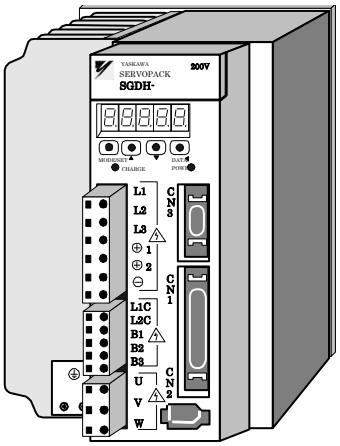
2.2 Servo Amplifiers

The SGDH servo amplifiers are base-mounted servoamps. Incorrect installation will cause problems. Follow the installation instructions below.

2.2.1 Storage Conditions

Store the servo amplifier within the following temperature range, as long as it is stored with the power cable disconnected.

-20 to 85°C



Sigma II series servo amplifier

2.2.2 Installation Site

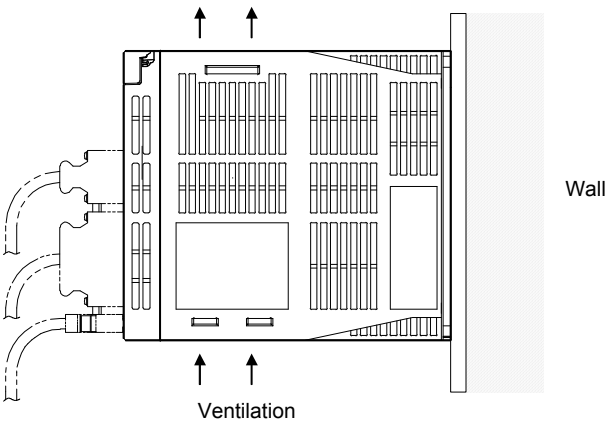
The following precautions apply to the installation site.

Situation	Installation Precaution
Installation in a Control Panel	Design the control panel size, unit layout, and cooling method so the temperature around the servo amplifier does not exceed 55°C.
Installation Near a Heating Unit	Minimize heat radiated from the heating unit as well as any temperature rise caused by natural convection so the temperature around the servo amplifier does not exceed 55°C.
Installation Near a Source of Vibration	Install a vibration isolator beneath the servo amplifier to avoid subjecting it to vibration.
Installation at a Site Exposed to Corrosive Gas	Corrosive gas does not have an immediate effect on the servo amplifier, but will eventually cause electronic components and contactor-related devices to malfunction. Take appropriate action to avoid corrosive gas.
Other Situations	Do not install the servo amplifier in hot and humid locations or locations subject to excessive dust or iron powder in the air.

2.2.3 Orientation

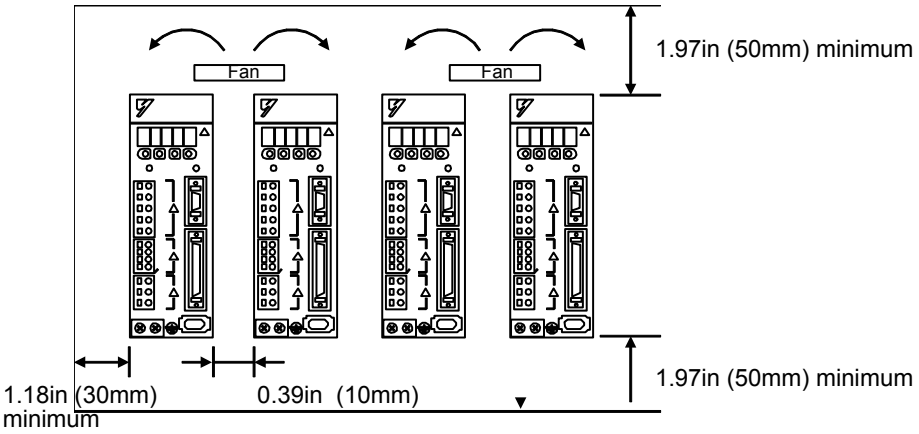
Install the servo amplifier perpendicular to the wall as shown in the figure. The servo amplifier must be oriented this way because it is designed to be cooled by natural convection or by a cooling fan.

Secure the servo amplifier using the mounting holes. The number of holes varies (from two to four) with the frame size of the servo amplifier.



2.2.4 Installation

Follow the procedure below to install multiple servo amplifiers side by side in a control panel.



■ Servo Amplifier Orientation

Install the servo amplifier perpendicular to the wall so the front panel containing connectors faces outward.

■ Cooling

As shown in the figure above, allow sufficient space around each servo amplifier for cooling by cooling fans or natural convection.

■ Side-by-side Installation

When installing servo amplifiers side by side as shown in the figure above, allow at least 0.39in (10mm) between and at least 1.97in (50mm) above and below each servo amplifier. Install cooling fans above the servo amplifiers to avoid excessive temperature rise and to maintain even temperature inside the control panel.

■ Environmental Conditions in the Control Panel

- Ambient Temperature: 0 to 55°C
- Humidity: 90% or less
- Vibration: 0.5 G (4.9m/s^2)
- Condensation and Freezing: None
- Ambient Temperature for Long-term Reliability: 45°C maximum

NOTES:

3 Wiring

This chapter describes the procedure used to connect Sigma II Series products to peripheral devices and gives typical examples of main circuit wiring as well as I/O signal connections.

3.1 Connecting to Peripheral Devices 3-3
3.1.1 Single-Phase (100V or 200V) Main Circuit Specifications 3-4
3.1.2 Three-Phase (200V) Main Circuit Specifications 3-5
3.1.3 Three-Phase (400V) Main Circuit Specifications 3-6
3.2 Servo Amplifier Internal Block Diagrams 3-7
3.2.1 30W to 400W (200V) and 30W to 200W (100V) Models 3-7
3.2.2 0.5kW to 1.5kW (200V) Models 3-8
3.2.3 2.0 kW to 5.0kW (200V) Models 3-8
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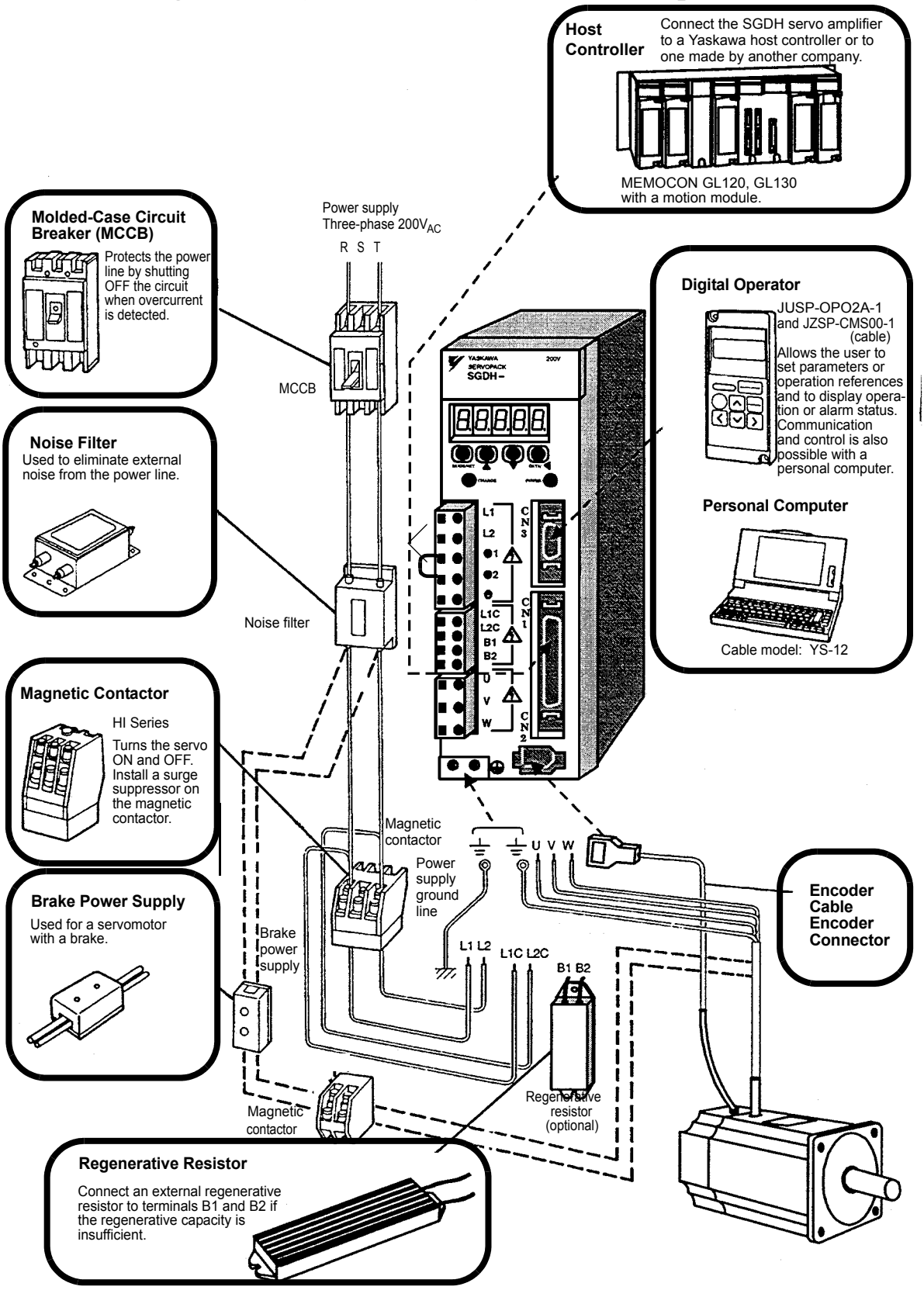
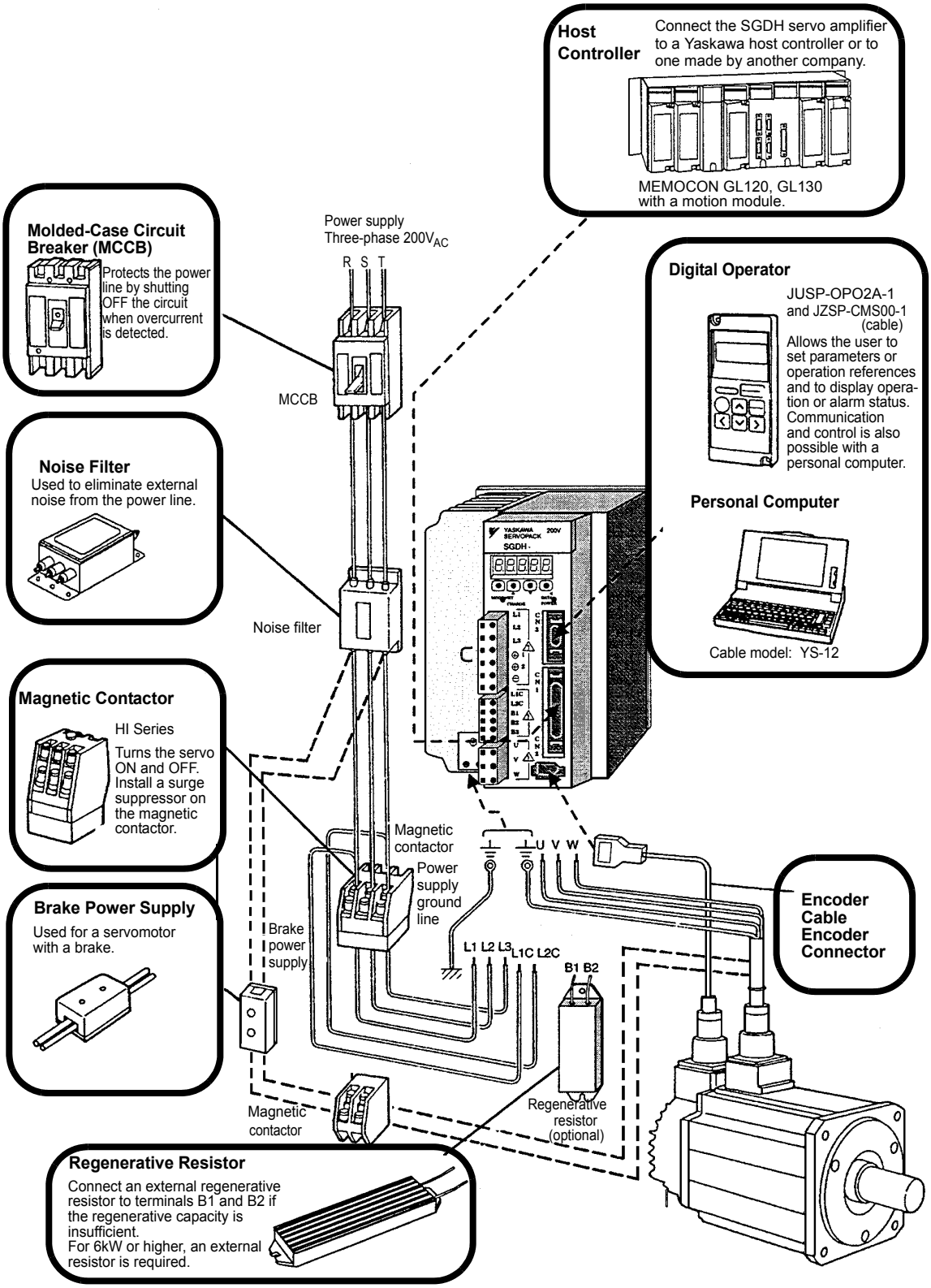
3.1 Connecting to Peripheral Devices

This section provides examples of standard Sigma II Series product connections to peripheral devices.
It also briefly explains how to connect each peripheral device.

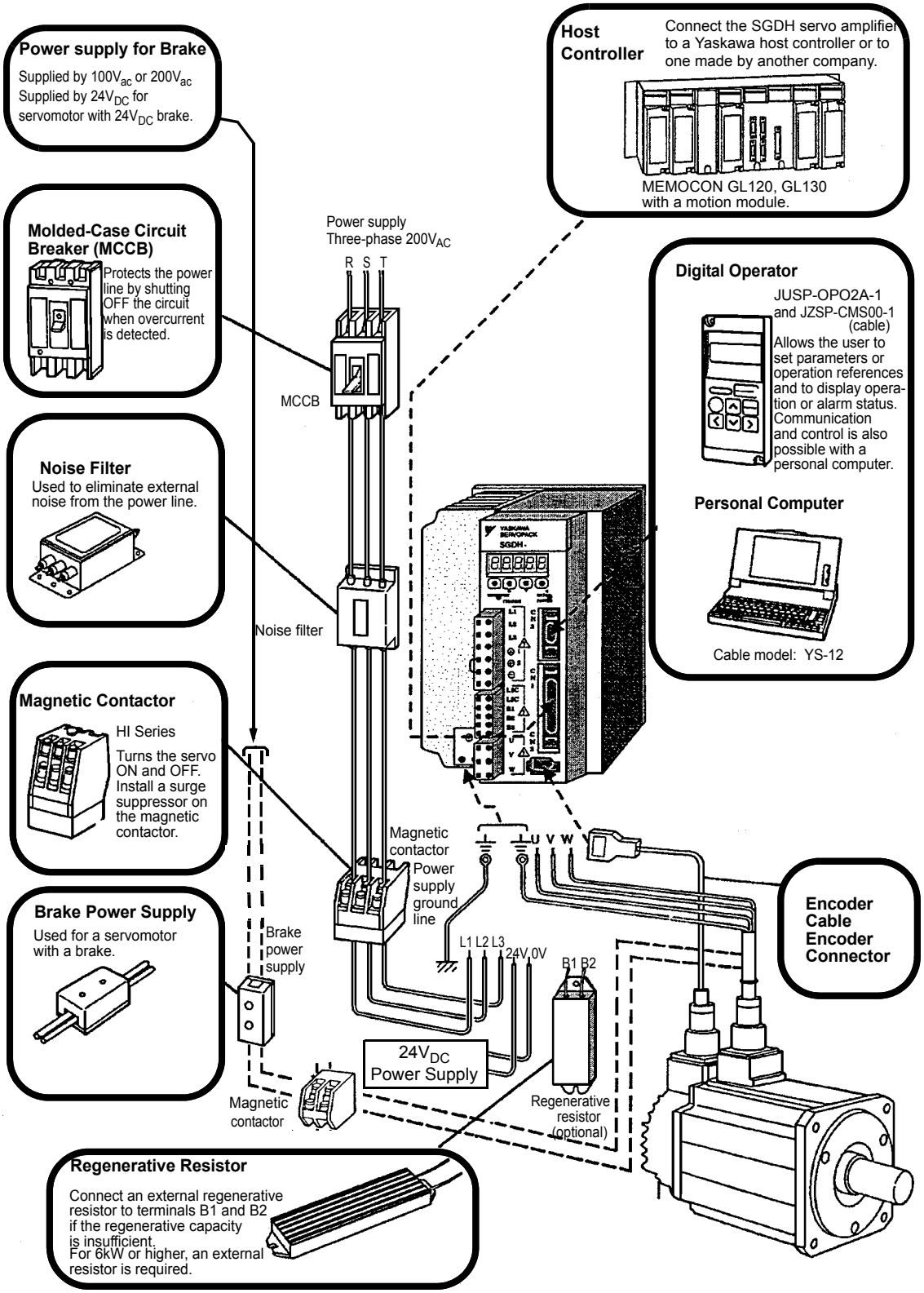
3.1.1 Single-Phase (100V or 200V) Main Circuit Specifications


Host Controller
Connect the SGDH servo amplifier to a Yaskawa host controller or to one made by another company.
MEMOCON GL120, GL130 with a motion module.
Molded-Case Circuit Breaker (MCCB)
Protects the power line by shutting OFF the circuit when overcurrent is detected.
Power supply
Three-phase 200V$_{AC}$
R S T
MCCB
Digital Operator
JUSP-OPO2A-1 and JZSP-CMS00-1 (cable)
Allows the user to set parameters or operation references and to display operation or alarm status. Communication and control is also possible with a personal computer.
Personal Computer
Cable model: YS-12
Noise Filter
Used to eliminate external noise from the power line.
Noise filter
Magnetic Contactor
HI Series
Turns the servo ON and OFF. Install a surge suppressor on the magnetic contactor.
Magnetic contactor
Power supply ground line
U V W
Encoder Cable Encoder Connector
Brake Power Supply
Used for a servomotor with a brake.
Brake power supply
L1 L2
L1C L2C
B1 B2
Regenerative resistor (optional)
Magnetic contactor
Regenerative Resistor
Connect an external regenerative resistor to terminals B1 and B2 if the regenerative capacity is insufficient.

3.1.2 Three-Phase (200V) Main Circuit Specifications


Host Controller
Connect the SGDH servo amplifier to a Yaskawa host controller or to one made by another company.
MEMOCON GL120, GL130 with a motion module.
Molded-Case Circuit Breaker (MCCB)
Protects the power line by shutting OFF the circuit when overcurrent is detected.
Power supply
Three-phase 200V$_{AC}$
R S T
MCCB
Digital Operator
JUSP-OPO2A-1 and JZSP-CMS00-1 (cable)
Allows the user to set parameters or operation references and to display operation or alarm status. Communication and control is also possible with a personal computer.
Personal Computer
Cable model: YS-12
Noise Filter
Used to eliminate external noise from the power line.
Noise filter
Magnetic Contactor
HI Series
Turns the servo ON and OFF. Install a surge suppressor on the magnetic contactor.
Magnetic contactor
Power supply ground line
U V W
Encoder Cable
Encoder Connector
Brake Power Supply
Used for a servomotor with a brake.
Brake power supply
L1 L2 L3 L1C L2C
B1 B2
Regenerative resistor (optional)
Magnetic contactor
Regenerative Resistor
Connect an external regenerative resistor to terminals B1 and B2 if the regenerative capacity is insufficient.
For 6kW or higher, an external resistor is required.

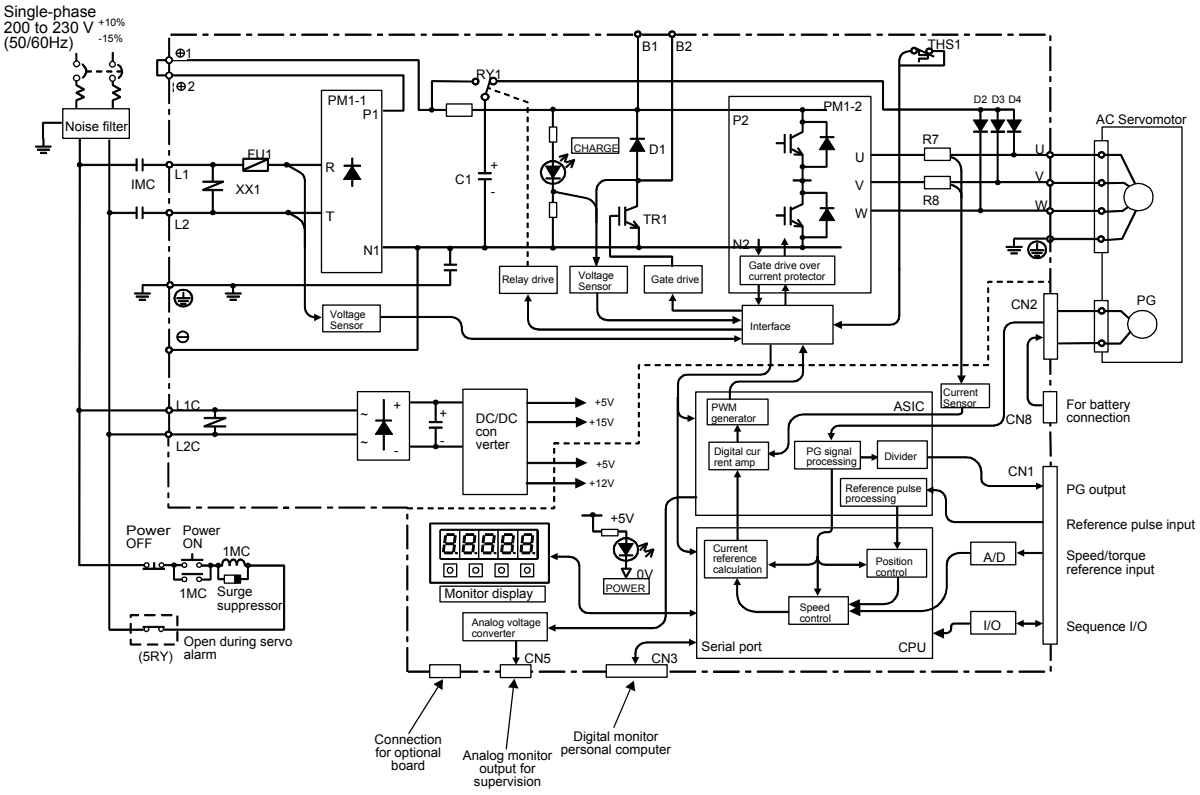
3.1.3 Three-Phase (400V) Main Circuit Specifications


Power supply for Brake
Supplied by 100Vac or 200Vac
Supplied by 24VDC for servomotor with 24VDC brake.
Molded-Case Circuit Breaker (MCCB)
Protects the power line by shutting OFF the circuit when overcurrent is detected.
Noise Filter
Used to eliminate external noise from the power line.
Magnetic Contactor
HI Series
Turns the servo ON and OFF. Install a surge suppressor on the magnetic contactor.
Brake Power Supply
Used for a servomotor with a brake.
Regenerative Resistor
Connect an external regenerative resistor to terminals B1 and B2 if the regenerative capacity is insufficient.
For 6kW or higher, an external resistor is required.
Host Controller
Connect the SGDH servo amplifier to a Yaskawa host controller or to one made by another company.
MEMOCON GL120, GL130 with a motion module.
Digital Operator
JUSP-OPO2A-1 and JZSP-CMS00-1 (cable)
Allows the user to set parameters or operation references and to display operation or alarm status. Communication and control is also possible with a personal computer.
Personal Computer
Cable model: YS-12
Power supply
Three-phase 200VAC
R S T
MCCB
Noise filter
Magnetic contactor
Power supply ground line
Brake power supply
Magnetic contactor
24VDC Power Supply
L1 L2 L3
24V 0V
B1 B2
Regenerative resistor (optional)
U V W
Encoder Cable
Encoder Connector

3.2 Servo Amplifier Internal Block Diagrams

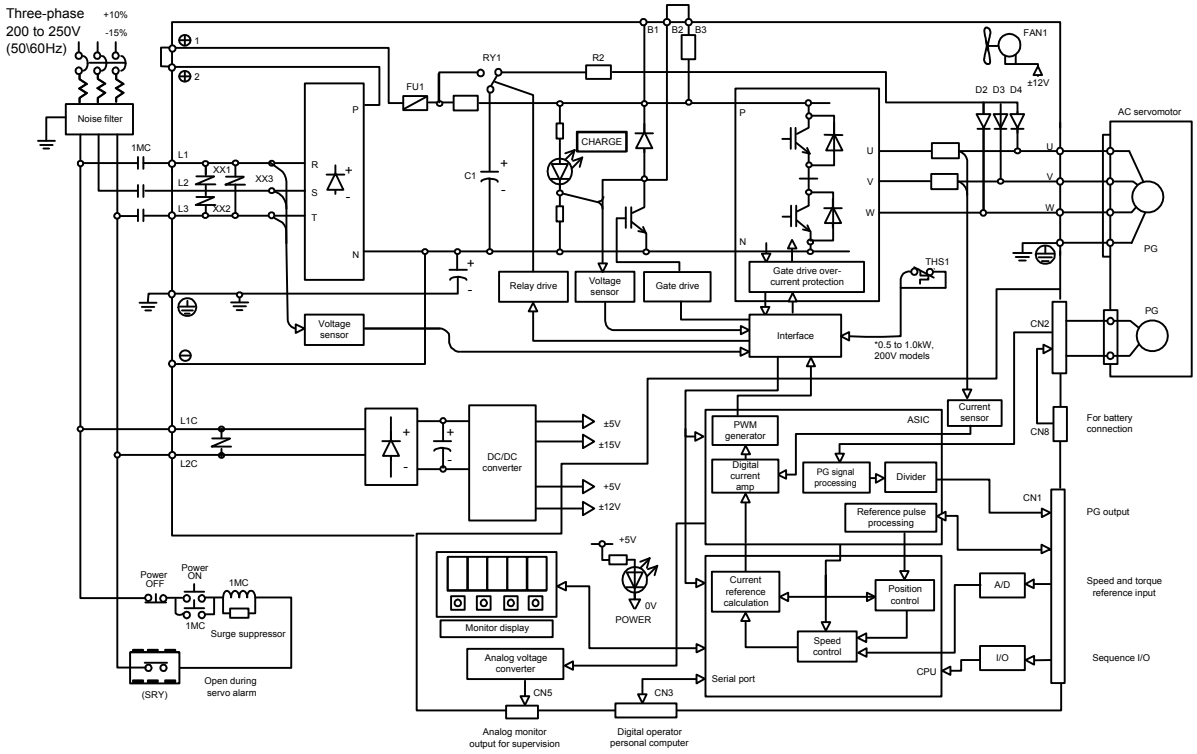
The following sections show internal block diagrams of the servo amplifiers.

3.2.1 30W to 400W (200V) and 30W to 200W (100V) Models

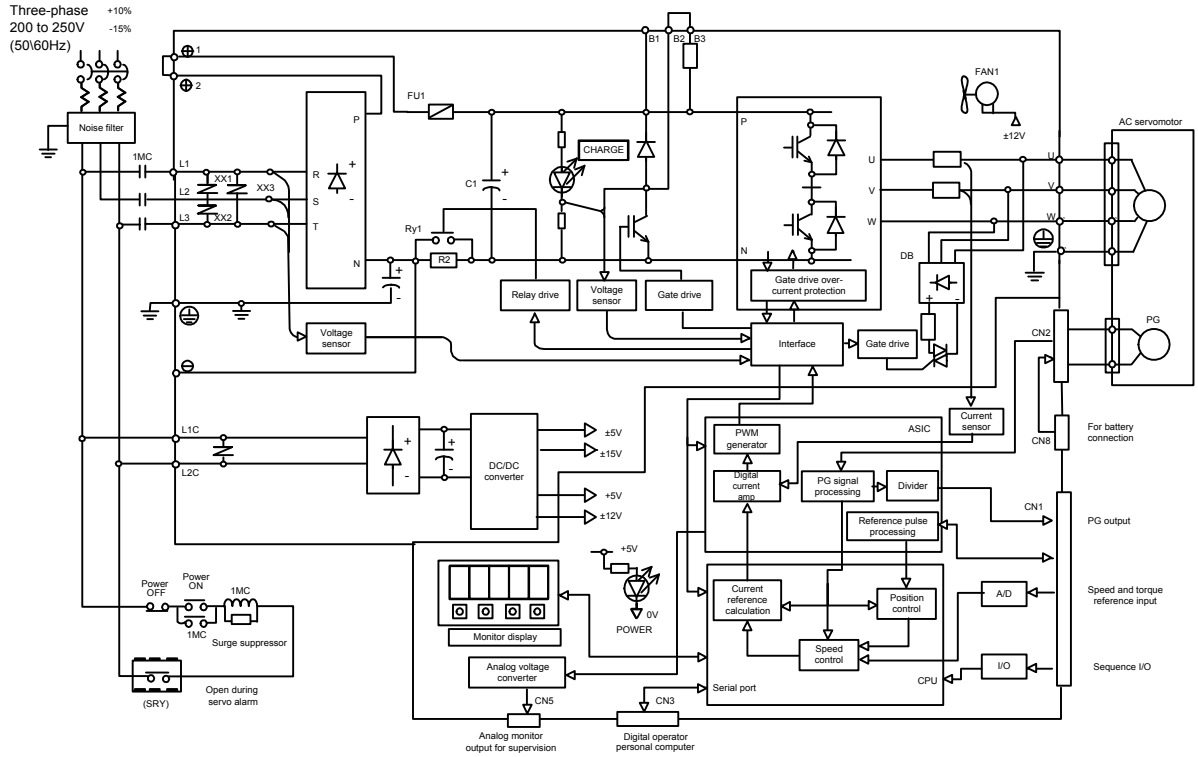


Note: The power supply voltage is 100 to 115V (+10% -15%), 50/60Hz for the 30 to 200W, 100V models.

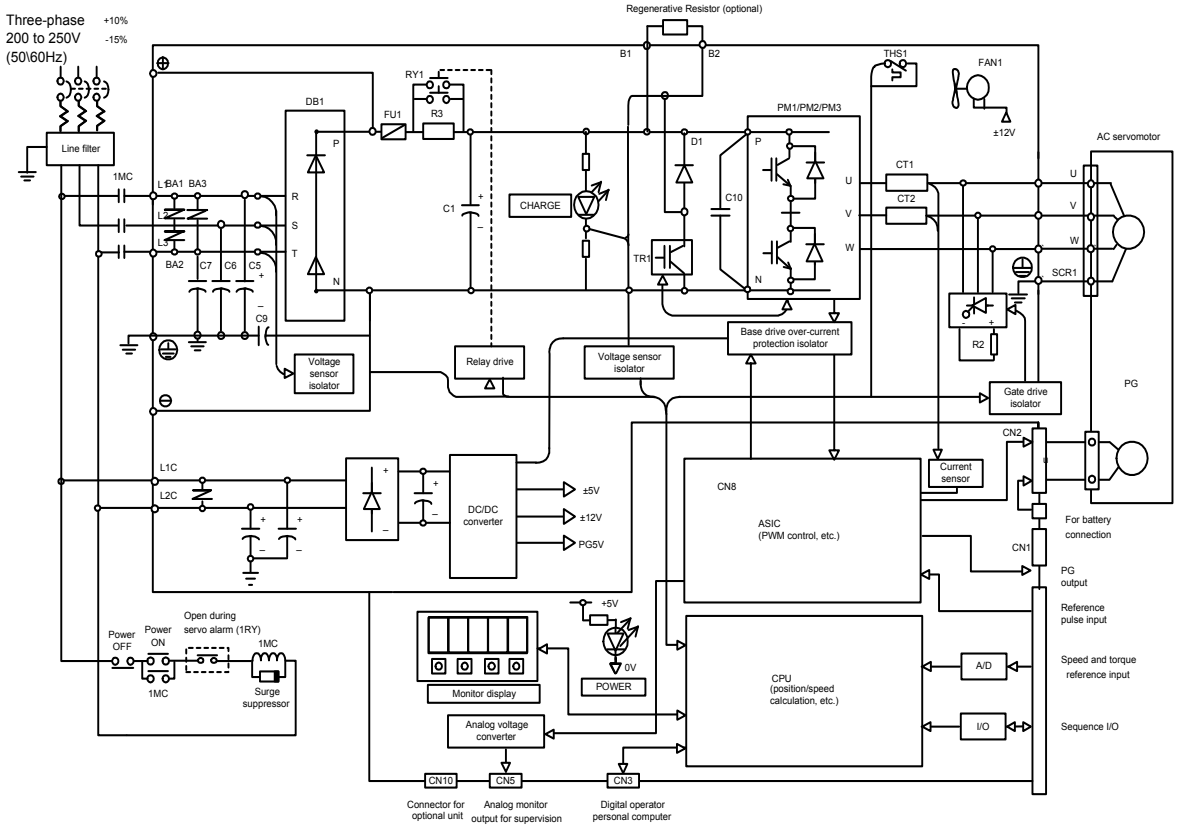
3.2.2 0.5kW to 1.5kW (200V) Models



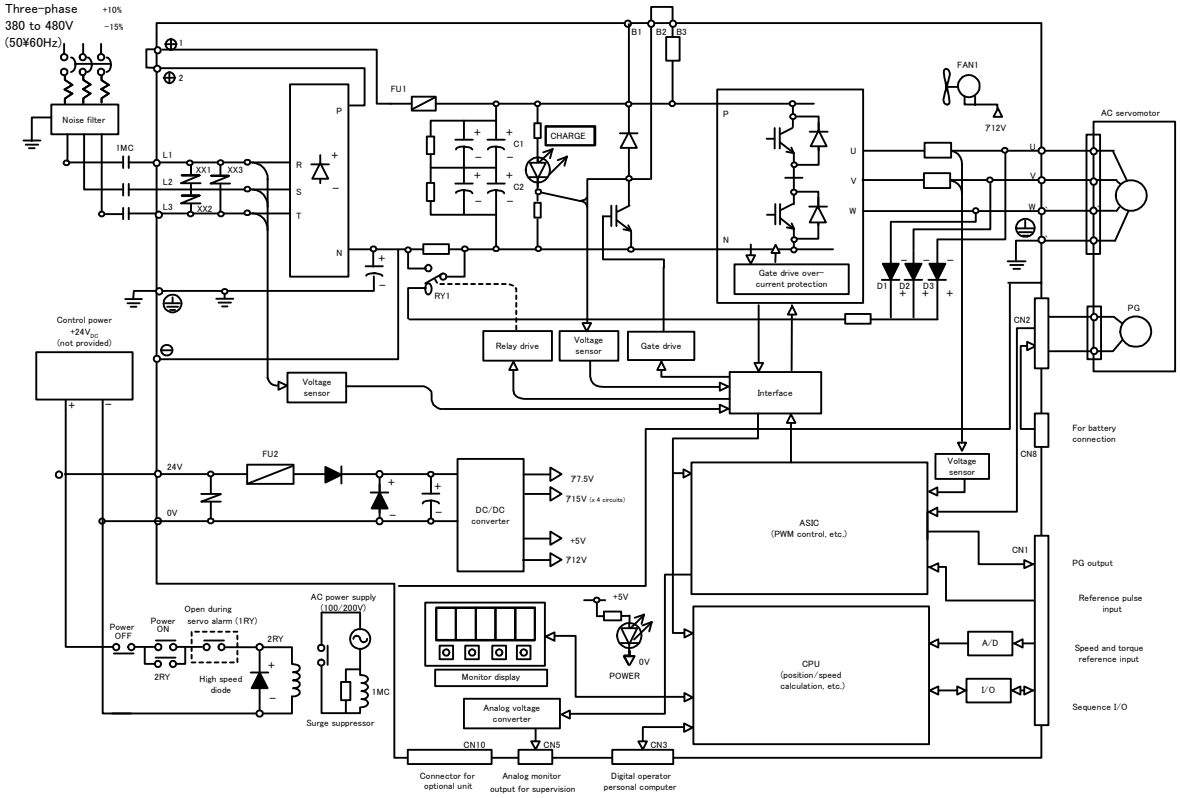
3.2.3 2.0 kW to 5.0kW (200V) Models



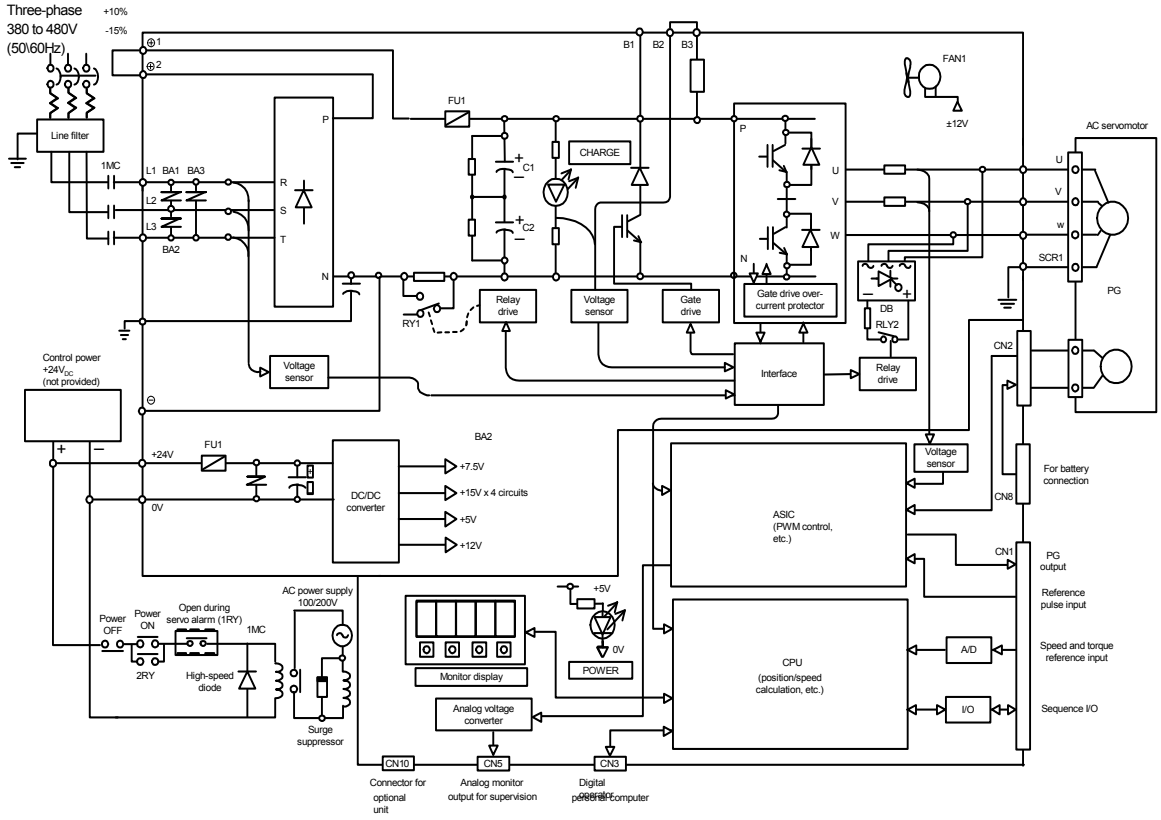
3.2.4 6.0kW to 15.0kW (200V) Models



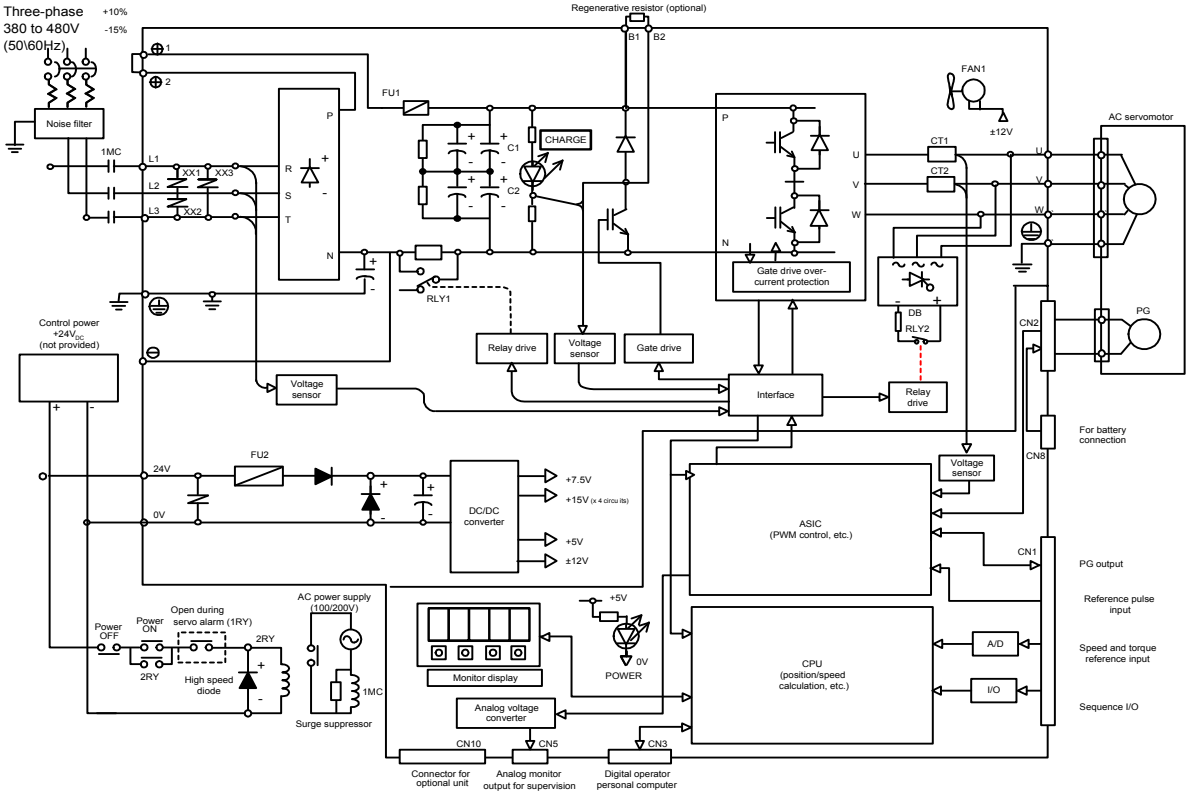
3.2.5 0.5kW to 3.0kW, 400V Models



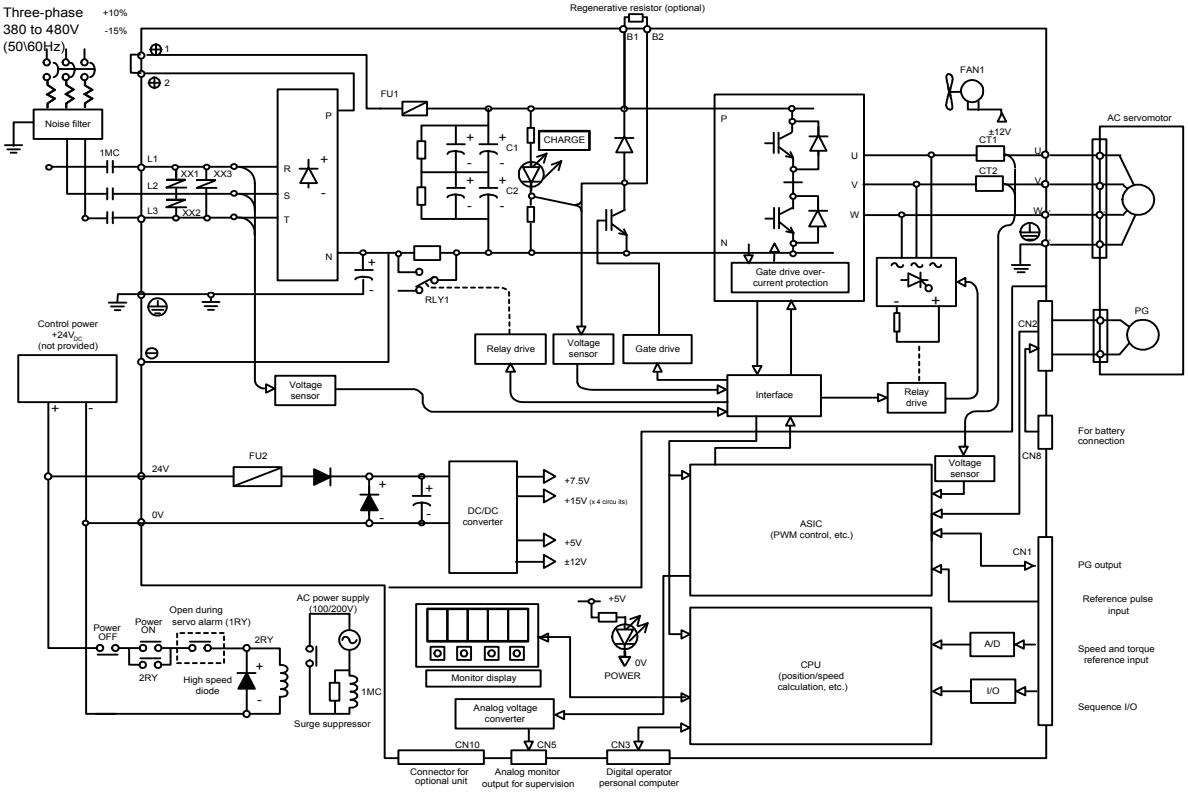
3.2.6 5.0kW (400V) Models



3.2.7 6.0kW to 7.5kW, 400V Models



3.2.8 11.0kW to 15.0kW (400V) Models



3.2.9 22.0kW to 55kW (400V) Models

Regarding Models SGDH-2BDE 22kW (400V), SGDH-3ZDE 30kW (400V), SDGH-3GDE 37kW (400V), SGDH-4EDE 45kW (400V), SGDH-5EDE 55kW (400V) consult factory for further information.

3.3 Main Circuit Wiring

This section shows typical examples of main circuit wiring for Sigma II Series servo products, functions of main circuit terminals, and the power ON sequence.

Observe the following precautions when wiring.

⚠ CAUTION

- **Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 11.81in (30cm)**
  Not doing so may cause a malfunction.
- **Use twisted pair wires or multi-core shielded-pair wires for signal and encoder (PG) feedback lines.out of control or malfunction.**
  The maximum length is 118.11in (3m) for reference input lines and is (787.40in (20m) out of control or malfunction.
- **Do not touch the power terminals for 5 minutes after turning power OFF because high voltage may still remain in the servo amplifier.**
- **Avoid frequently turning power ON and OFF. Do not turn power ON or OFF more than once per minute.**
  Since the servo amplifier has a capacitor in the power supply, a high charging current flows for 0.2s when power is turned ON. Frequently turning power ON and OFF causes main power devices like capacitors and fuses to deteriorate, resulting in unexpected problems.
- **Suitable for use on a circuit capable of delivering not more than 5000A_{rms} (symmetrical), 240V or 480V maximum. • Large-capacity (2B-5E): 31,000A**
  Must be used with UL listed fuses or circuit breakers, in accordance with the National Electrical Code.
- **Required for 7.5kW -15kW (200V) or 6kW-15kW (400V) amplifiers:**
  Must use ring terminals specified in Yaskawa Kits JZSP-CKT75, JZSP-CKT1E, JZSP-CKT75DE, JZSP-CKT1ADE, and JZSP-CKT1EDE for wiring of input and output power. Contact Yaskawa for details.

3.3.1 Names and Descriptions of Main Circuit Terminal

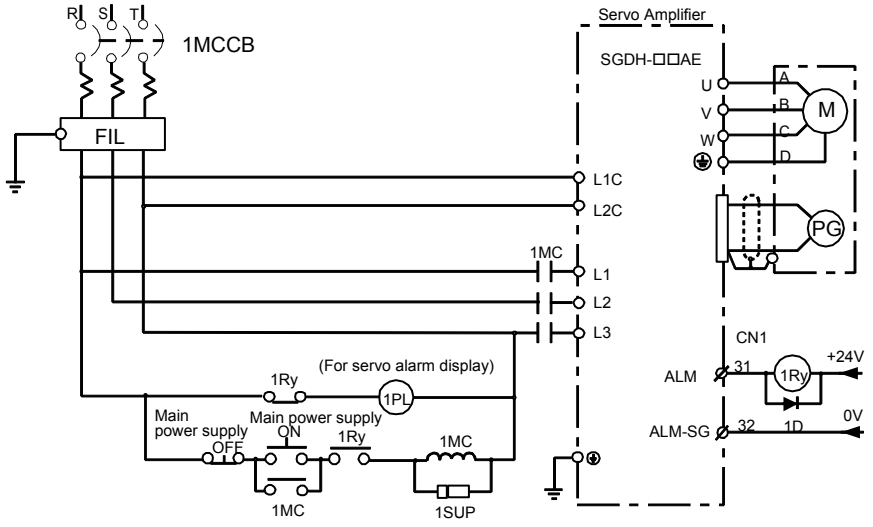
The following table gives the names and a description of main circuit terminals.

Main Circuit Names and Description

Terminal Symbol	Name	Description	
L1, L2 or L1, L2, L3	Main circuit AC input terminal	30W to 200W	Single-phase 100 to 115V (+10%, -15%), 50/60Hz
		30W to 400W	Single-phase 200 to 230V (+10%, -15%), 50/60Hz
		500W to 15kW 200V	Three-phase 200 to 230V (+10%, -15%), 50/60Hz
		500W to 55kW 400V	Three-phase 380 to 480V (+10%, -15%), 50/60Hz
U, V, W	Servomotor connection terminal	Connects to the Servomotor.	
L1C, L2C	Control power input terminal	30W to 200W	Single-phase 100 to 115V (+10%, -15%), 50/60Hz
		30W to 15kW	Single-phase 200 to 230V (+10%, -15%), 50/60Hz
24V, 0V		500W to 55kW	$24V_{DC}$ (±15%) 400V units only
⏚	Ground terminal	Connects to the power supply ground terminals and motor ground terminal.	
B1, B2 or B1, B2, B3	External regenerative resistor terminal	30W to 400W	Normally not connected. Connect an external regenerative resistor (provided by the user) between B1 and B2 if the regenerative capacity is insufficient. Note: No B3 terminal.
		500W to 5.0kW	Normally short B2 and B3 (for an internal regenerative resistor). Remove the wire between B2 and B3 and connect an external regenerative resistor (provided by customer) between B1 and B2 if the capacity of the internal regenerative resistor is insufficient.
B1, B2	—	6.0kW-55.0kW	Connect an external regenerative resistor (provided by the user) between terminals B1 and B2. *See 5.6 Selecting a Regenerative Resistor* for details.
⊕1, ⊕2	DC reactor terminal connection for power supply harmonic wave countermeasure	Normally short ⊕1 and ⊕2. If a countermeasure against power supply harmonic waves is needed, connect a DC reactor between ⊕1 and ⊕2. The amplifier is delivered from the factory with these terminals shorted. See *5.8.6 Reactor for Harmonic Suppression* for details.	
⊖	Main circuit Negative terminal	Normally not connected.	
⊕	Main circuit Positive terminal	Normally not connected.	

3.3.2 Typical Main Circuit Wiring Example

The following figure shows a typical example of main circuit wiring.



1MCCB: Molded-case circuit breaker (for the inverter)
FIL: Noise filter
1MC: Contactor

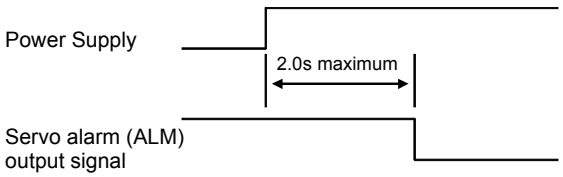
1Ry: Relay
1PL: Indicator lamp
1SUP: Surge suppressor
1D: Flyback diode

■ Designing a Power ON Sequence

Note the following when designing the power ON sequence.

Design the power ON sequence so that power is turned OFF when a servo alarm signal is output. (See the circuit figure above.)

- Hold the power ON button for at least two seconds. The servo amplifier will output a servo alarm signal for two seconds or less when power is turned ON. This is required in order to initialize the servo amplifier.



3.3.3 Cable Specifications and Peripheral Devices

Refer to the *Sigma II Series Servo System Catalog Supplement* (No. G-MI#99001).

3.3.4 Servo Amplifier Power Losses

The following table shows servo amplifier power losses at the rated output.

Servo Amplifier Power Losses at Rated Output

Main Circuit Power Supply	Maximum Applicable Servomotor Capacity [kW]	Servo Amplifier Model	Output Current (RMS Value) [A]	Main Circuit Power Loss [W]	Regenerative Resistor Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]
Single-phase 100V	0.03	SGDH-A3BE	0.66	3.5	—	13	16.5
	0.05	SGDH-A5BE	0.95	5.2			18.2
	0.10	SGDH-01BE	2.4	12			25
	0.20	SGDH-02BE	3.0	16.4			29.4
Single-phase 200V	0.03	SGDH-A3AE	0.44	3.1	—	13	16.1
	0.05	SGDH-A5AE	0.64	4.6			17.6
	0.10	SGDH-01AE	0.91	6.7			19.7
	0.20	SGDH-02AE	2.1	13.3			26.3
	0.40	SGDH-04AE	2.8	20			33
	0.75	SGDH-08AE-S	4.4	47	12	15	74
	1.50	SGDH-15AE-S	7.5	60	14		89
Three-phase 200V	0.45	SGDH-05AE	3.8	27	12	15	54
	0.75	SGDH-08AE	5.7	41			68
	1.0	SGDH-10AE	7.6	55			82
	1.5	SGDH-15AE	11.6	92	14		152
	2.0	SGDH-20AE	18.5	120	28		163
	3.0	SGDH-30AE	24.8	155			198
	5.0	SGDH-50AE	32.9	240	56		311
	6.0	SGDH-60AE	46.9	290	—	27	317
	7.5	SGDH-75AE	54.7	330			357
	11.0	SGDH-1AAE	58.6	360		30	390
	15.0	SGDH-1EAE	78.0	490			520
Three-phase 400V	0.45	SGDH-05DE	1.9	19	14	15	48
	1.0	SGDH-10DE	3.5	35			64
	1.5	SGDH-15DE	5.4	53			82
	2.0	SGDH-20DE	8.4	83	28		126
	3.0	SGDH-30DE	11.9	118			161
	5.0	SGDH-50DE	16.5	192	36		243
	6.0	SGDH-60DE	20.8	232	—		247
	7.5	SGDH-75DE	25.4	264			279
	11.0	SGDH-1ADE	28.1	288			303
	15.0	SGDH-1EDE	37.2	392			407
	22.0	SGDH-2BDE	58.0	650		120	770
	30.0	SGDH-3ZDE	80.0	970			1090
	37.0	SGDH-3GDE	100.0	1140			1260
	45.0	SGDH-4EDE	127.0	1440			1560
	55.0	SGDH-5EDE	150.0	1720			1840

Note Regenerative resistor power losses are allowable losses. Take the following action if this value is exceeded:

- Disconnect the internal regenerative resistor in the servo amplifier by removing the wire between terminals B2 and B3.
- Install an external regenerative resistor between terminals B1 and B2.
- An external regenerative resistor must be connected to amplifiers with capacity of 6kW or higher.

See 5.6 Selecting a Regenerative Resistor for more details on the resistors.

3.3.5 Wiring Main Circuit Terminal Blocks

Observe the following precautions when wiring main circuit terminal blocks.

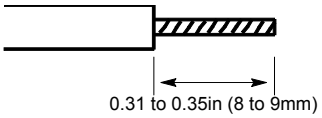
⚠ CAUTION

- Remove the terminal block from the servo amplifier prior to wiring.
- Insert only one wire per terminal on the terminal block.
- Make sure that the core wire is not electrically shorted to adjacent core wires.
- Reconnect any wires that were accidentally pulled out.

Servo amplifiers with a capacity below 1.5kW will have connector-type terminal blocks for main circuit terminals. Follow the procedure below when connecting to the terminal block.

■ Connection Procedure

- Strip the end of the wire, leaving the ends twisted together.



- Open the wire insert opening of the terminal block (plug) with a tool using either of the two procedures shown in Fig. A and Fig. B on the following page.

1. **Fig. A:** Use the provided lever to open the wire insert opening .

   Fig. B: Using a commercially available 1/8in (3.0 to 3.5mm) slotted screwdriver, press down firmly on the screwdriver insert opening to release the wire insert slot.

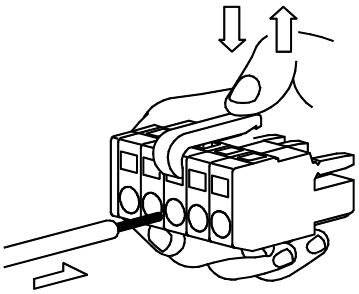


Fig. A

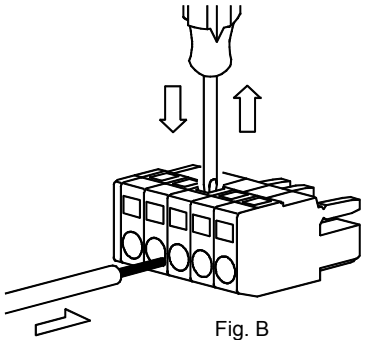


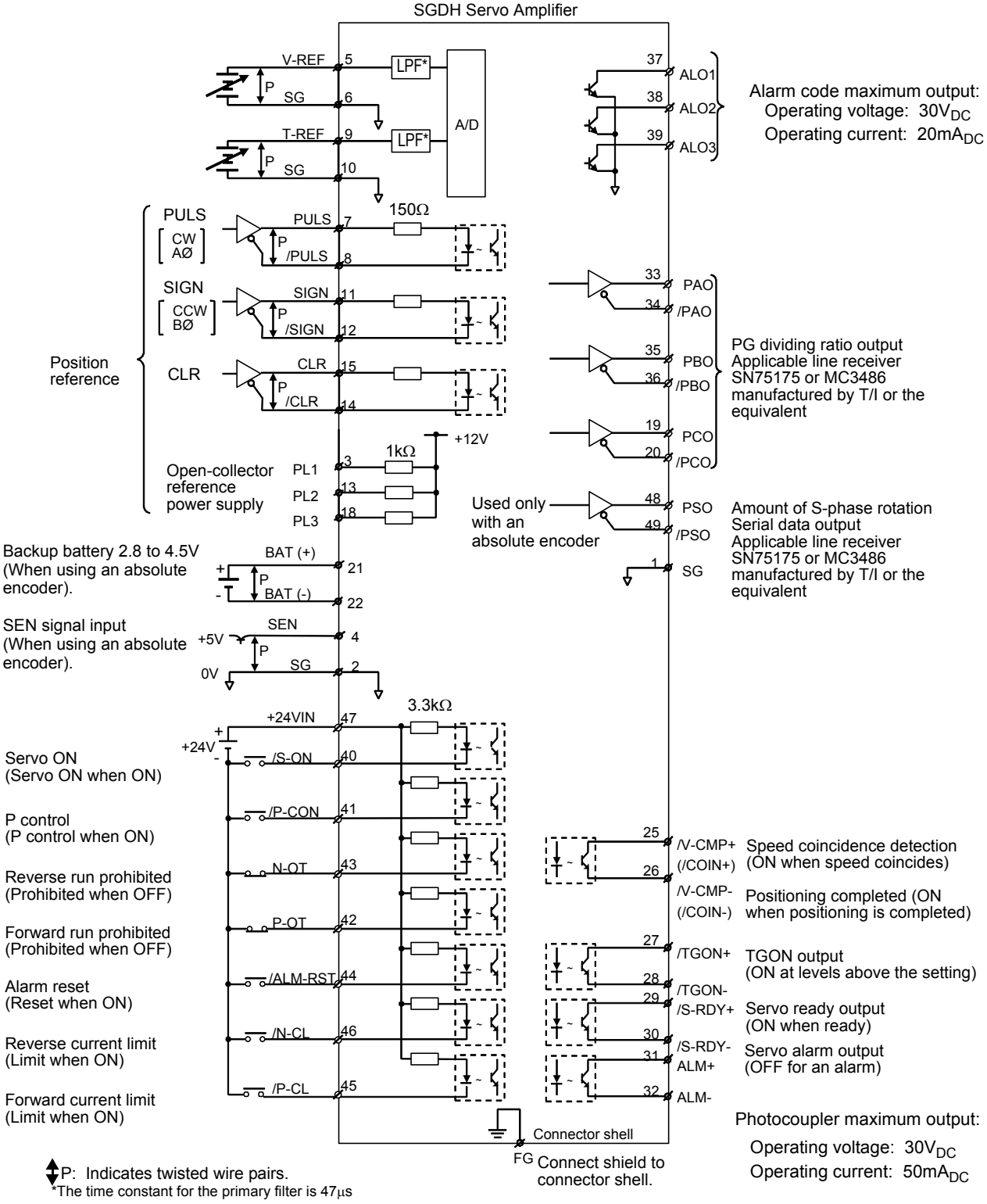
Fig. B

2. **Figs A and B**: Insert the wire end into the opening and then clamp it tightly by releasing either the lever or the screwdriver.

3.4 I/O Signals

This section describes I/O signals for the SGDH servo amplifier

3.4.1 Example of Typical I/O Signal Connections



3.4.2 List of CN1 Terminals

The following diagram shows the layout and specifications of CN1 terminals.

CN1 Terminal Layout

			1	SG	GND				26	/V-CMP- (/COIN-)	Speed coincidence detection output
2	SG	GND				27	/TGON+	TGON signal output			
			3	PL1	Open-collector reference power supply				28	/TGON	TGON signal output
4	SEN	SEN signal input				29	/S-RDY+	Servo ready output			
			5	V-REF	Reference speed input				30	/S-RDY	Servo ready output
6	SG	GND				31	ALM+	Servo alarm output			
			7	PULS	Reference pulse input				32	ALM	Servo alarm output
8	/PULS	Reference pulse input				33	PAO	PG divided output A-phase			
			9	T-REF	Torque reference input				34	/PAO	PG divided output A-phase
10	SG	GND				35	PBO	PG divided output B-phase			
			11	SIGN	Reference sign input				36	/PBO	PG divided output B-phase
12	/SIGN	Reference symbol input				37	AL01	Alarm code output			
			13	PL2	Open-collector reference power supply				38	AL02	Alarm code output
14	/CLR	Clear input				39	AL03	Open-collector output			
			15	CLR	Clear input				40	/S-ON	Servo ON input
16	—	—				41	P-CON	P operation input			
			17	—	—				42	P-OT	Forward overtravel input
18	PL3	Open-collector reference power supply				43	N-OT	Reverse overtravel input			
			19	PCO	PG divided output C-phase				44	/ALM-RST	Alarm reset input
20	/PCO	PG divided output C-phase				45	/P-CL	Forward current limit ON input			
			21	BAT (+)	Battery (+)				46	/N-CL	Reverse current limit ON input
22	BAT (-)	Battery (-)				47	+24V -IN	External input power supply			
			23	—	—				48	PSO	S-phase signal output
24	—	—				49	/PSO	S-phase signal output			
			25	/V-CMP+ (/COIN+)	Speed coincidence detection output				50	—	—

Note 1. Do not use unused terminals for relays.

2. Connect the shield of the I/O signal cable to the connector shell.
Connect the shield to the FG (frame ground) at the servo amplifier-end connector shell only.

■ CN1 Specifications

Specifications for Servo Amplifier Connectors	Applicable Receptacles		
	Solder Type	Case	Manufacturer
10250-52A2JL or Equivalent 50-pin Right Angle Plug	10150-3000VE	10350-52A0-008	Sumitomo 3M Co.

3.4.3 I/O Signal Names and Functions

The following section describes servo amplifier I/O signal names and functions.

■ Input Signals

Signal Name		Pin No.	Function		Reference
Common	/S-ON	40	Servo ON: Turns ON the servomotor when the gate block in the inverter is released.		5.5.2
	/P-CON	41	* Function selected via parameter.		5.2.1 5.2.7
			Proportional operation reference	Switches the speed control loop from PI (proportional/integral) to P (proportional) control when ON.	5.2.1
			Direction reference	With internal reference speed selected: switches the direction of rotation.	5.2.6
			Control mode switching	Position ⇄ Speed Speed ⇄ Torque Torque ⇄ Speed } Enables control mode switching	5.2.7
			Zero-clamp reference	Speed control with zero-clamp function: reference speed is zero when ON.	5.4.3
			Reference pulse block	Position control with reference pulse stop: stops reference pulse input when ON.	5.2.10
	P-OT N-OT	42 43	Forward Run prohibited Reverse Run prohibited	Overtravel prohibited: stops servomotor when movable part travels beyond the allowable range of motion.	5.1.2
	/P-CL /N-CL	45 46	* Function selected with a parameter.		—
			Forward current limit ON Reverse current limit ON	Current limit function used when ON.	5.1.3
			Internal speed switching	With internal reference speed selected: switches the internal speed settings.	5.2.6
	/ALM-RST	44	Alarm reset: Releases the servo alarm state.		5.5.1
	$+24V_{IN}$	47	Control power supply input for sequence signals: users must provide the +24V power supply.		5.2.4
	SEN	4 (2)	Initial data request signal when using an absolute encoder.		5.2.3
	BATT(+) BATT(-)	21 22	Connecting pins for the absolute encoder backup battery.		5.2.3
Speed Reference	V-REF	5 (6)	Speed reference input: ±2 to ±10V/rated motor speed (Input gain can be modified with a parameter Pn300.)		5.2.1
Torque Reference	T-REF	9 (10)	Torque reference input: ±1 to ±10V/rated motor speed (Input gain can be modified by parameter Pn400.)		5.2.1
Position Reference	PULS /PULS SIGN /SIGN	7 8 11 12	Corresponds to reference pulse input Line-driver Open-collector	Input mode • Code + pulse string • CCW/CW pulse • Two-phase pulse (90° phase differential)	5.2.1
	CLR /CLR	15 14	Error counter clear: Clears the error counter during position control.		5.2.1
	PL1 PL2 PL3	3 13 18	+12V pull-up power supply when PULS, SIGN and CLR reference signals are open-collector outputs (+12V power supply is built into the servo amplifier).		5.2.1

Note 1. The functions allocated to /S-ON, /P-CON. P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL input signals can be changed with parameters. (See 5.3.3 Input Circuit Signal Allocation .)

2. Pin numbers in parenthesis ( ) indicate signal grounds.

3. The voltage input range for speed and torque references is a maximum of ±12V.

■ Output Signals

Signal Name		Pin Number	Function		Reference
Common	ALM+ ALM-	31 32	Servo alarm: Turns OFF when an error is detected.		5.5.1
	/TGON+ /TGON-	27 28	Detection during servomotor rotation: detects whether the servomotor is rotating at a speed higher than the motor speed setting. Motor speed detection can be set via parameter.		5.5.5
	/S-RDY+ /S-RDY-	9 30	Servo ready: ON if there is no servo alarm when the control/main circuit power supply is turned ON.		5.5.6
	PAO /PAO PBO /PBO PCO /PCO	33 (1) 34 35 36 19 20	A phase signal B phase signal C phase signal	Converted two-phase pulse (A and B phase) encoder output signal and origin pulse (C phase) signal: RS-422 or the equivalent.	5.2.3
	PSO /PSO	48 49	S phase signal	With an absolute encoder: outputs serial data corresponding to the number of revolutions (RS-422 or equivalent).	
	ALO1 ALO2 ALO3	37 38 39 (1)	Alarm code output: Outputs 3-bit alarm codes. Open-collector: 30V and 20mA rating maximum.		5.5.1
	FG	Shell	Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.		
Speed	/V-CMP+ /V-CMP-	25 26	Speed coincidence (output in Speed Control Mode): detects whether the motor speed is within the setting range and if it matches the reference speed value.		5.5.4
Position	/COIN+ /COIN-	25 26	Positioning completed (output in Position Control Mode): turns ON when the number of error pulses reaches the value set. The setting is the number of error pulses set in reference units (input pulse units defined by the electronic gear).		5.5.3
Not used.		16 17 23 24 50	These terminals are not used. Do not connect relays to these terminals.		—

Note **1.** Pin numbers in parenthesis () indicate signal grounds.

2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed via parameters. Functions /CLT, /VCT, /BK, /WARN, and /NEAR signals can also be changed. (See 5.3.4 Output Circuit Signal Allocation).

3.4.4 Interface Circuits

This section shows examples of servo amplifier I/O signal connection to the host controller.

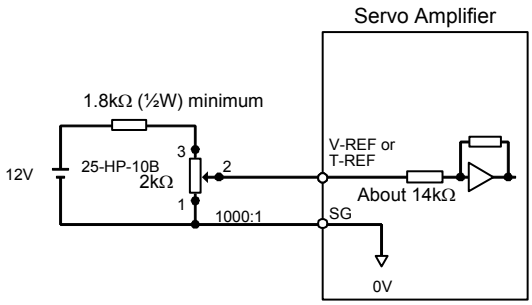
■ Interface for Reference Input Circuits

Analog Input Circuit

Analog signals are either speed or torque reference signals at the impedance below.

- Speed reference input: About 14kΩ
- Torque reference input: About 14kΩ

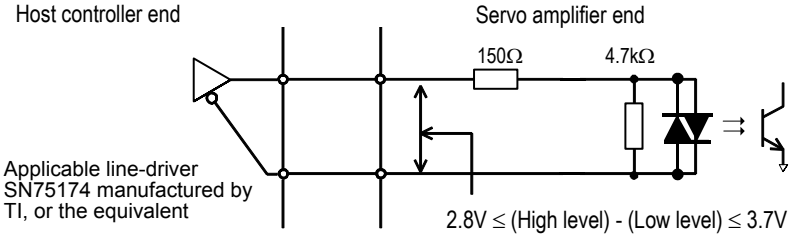
The maximum allowable voltage for input signals is ±12V.



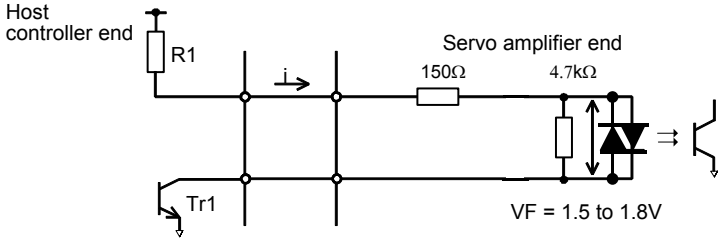
Reference Position Input Circuit

An output circuit for the reference pulse and error counter clear signal at the host controller can be either line-driver or open-collector outputs. These are shown below by type.

- Line-driver Output Example:



- Open-collector Output, Example 1: External power supply

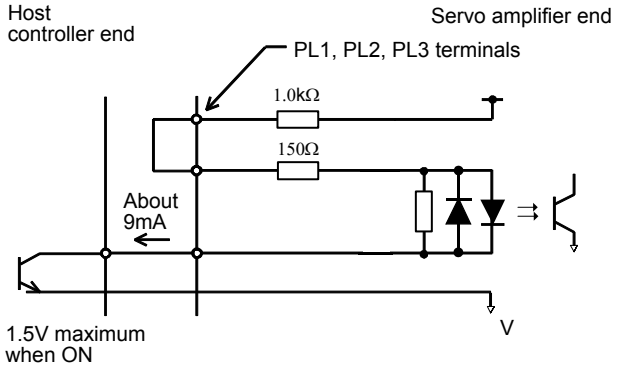


The following examples show how to select the pull-up resistor R1 so the input current (I) falls between 7 and 15mA.

Application Examples		
R1 = 2.2kΩ with V_{CC} = 24V ±5%	R1 = 1kΩ with V_{CC} = 12V ±5%	R1 = 180Ω with V_{CC} = 5V ±5%

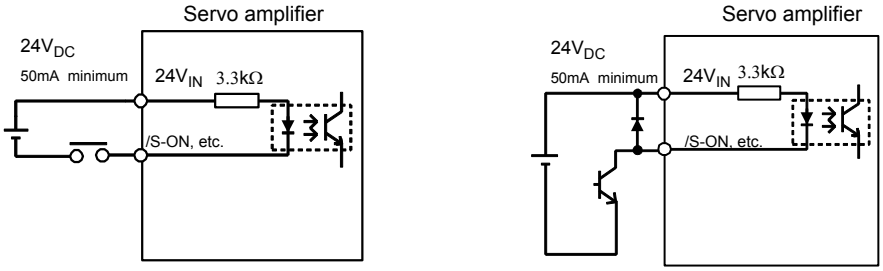
- Open-collector Output, Example 2: Using a servo amplifier with an internal 12V power supply

  This circuit uses the 12V power supply built into the servo amplifier. The input is not isolated in this case.



■ Sequence Input Circuit Interface

The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay, otherwise a faulty contact will result.



■ Output Circuit Interfaces

Any of the following three types of servo amplifier output circuits can be used. Connect an input circuit at the host controller following one of these types.

- Connecting to a Line-driver Output Circuit

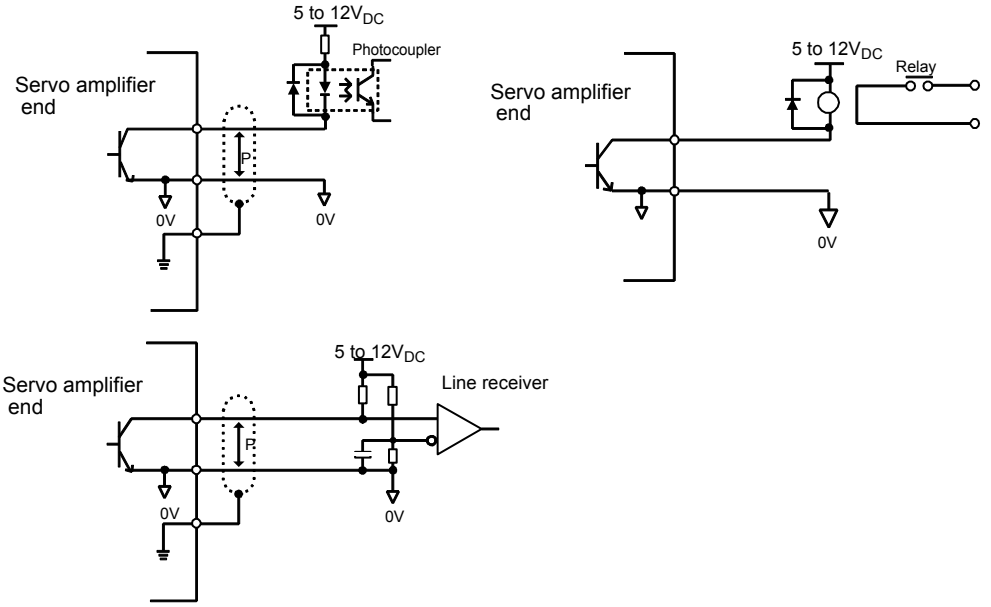
  Encoder serial data converted to two-phase (A and B phase) pulse output signals (PAO, /PAO, PBO, /PBO), origin pulse signals (PCO, /PCO) and S phase rotation signals (PCO, /PCO) are output via line-driver output circuits that normally comprise the position control system at the host controller. Connect the line-driver output circuit through a line receiver circuit at the host controller.

See 3.5 Wiring Encoders (for SGMGH and SGMSH Motors Only) for connection circuit examples.

- Connecting to an Open-collector Output Circuit

Alarm code signals are output from open-collector transistor output circuits.

Connect an open-collector output circuit through a photocoupler, relay, or line receiver circuit.

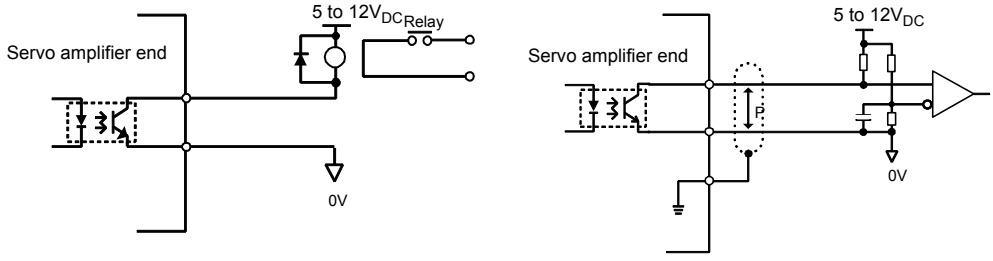


Note: The maximum allowable voltage and current capacities for open-collector circuits are:
- Voltage: 30V$_{DC}$
- Current: 20mA$_{DC}$

- Connecting to a Photocoupler Output Circuit

Photocoupler output circuits are used for servo alarm, servo ready, and other sequence output signal circuits.

Connect a photocoupler output circuit through a relay or line receiver circuit.



Note: The maximum allowable capacities for photocoupler output circuits are:
- Voltage: 30V$_{DC}$
- Current: 50mA$_{DC}$

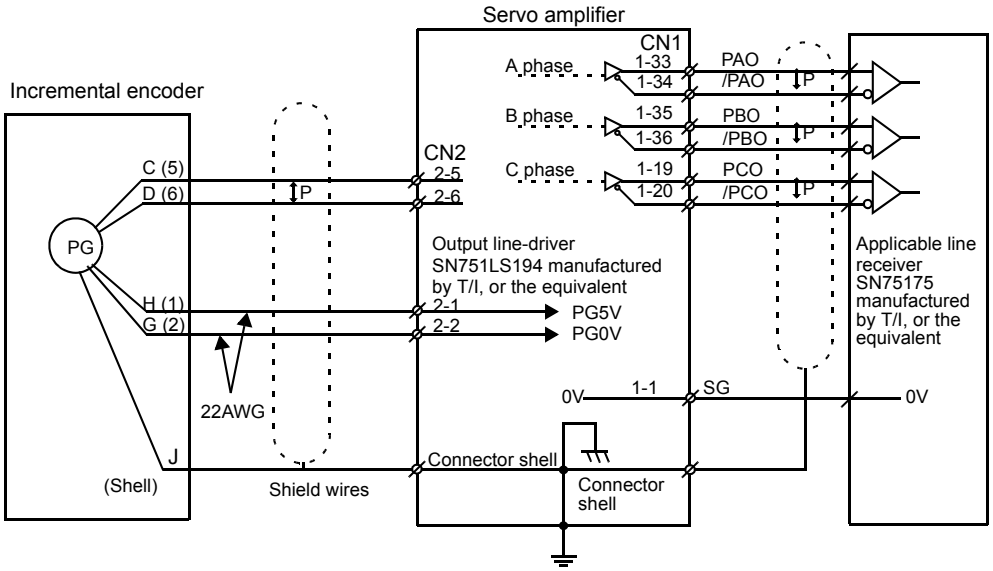
3.5 Wiring Encoders (for SGMGH and SGMSH Motors Only)

The following sections describe the procedure for wiring a servo amplifier to the encoder.

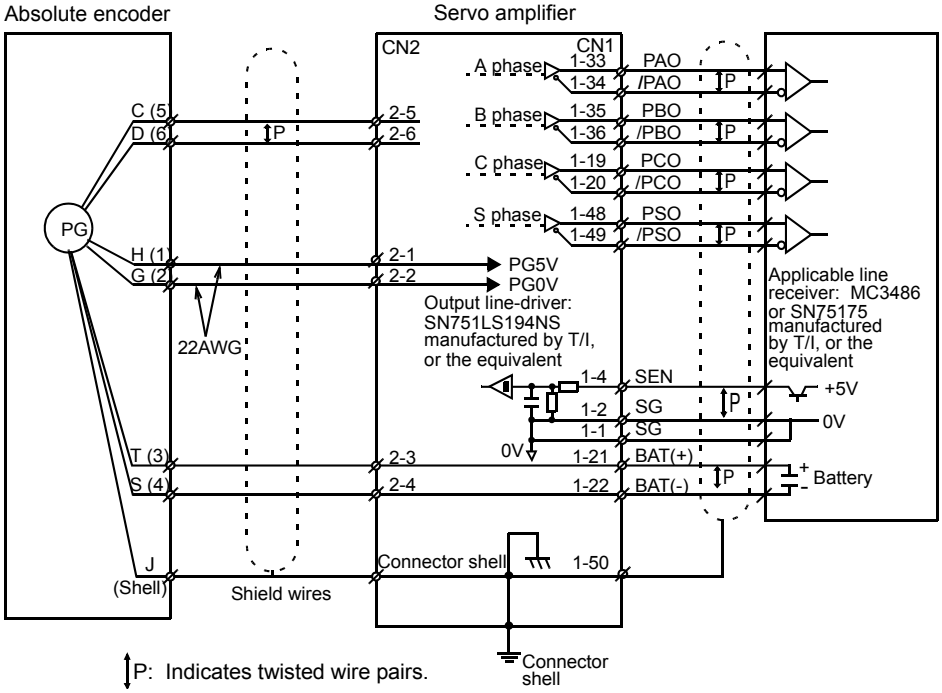
3.5.1 Encoder Connections

The following diagrams show the wiring of the encoder output from the motor to CN2 of the servo amplifier, and PG output signals from CN1 to the controller. This applies to both incremental and absolute encoders of SGMGH and SGMSH motors only. The numbers in parentheses ( ) are applicable to SGMAH motors. For SGMPH motors, refer to the Sigma II Servo System Product Catalog Supplement.

■ **Incremental Encoders**



■ Absolute Encoders



3.5.2 CN2 Encoder Connector Terminal Layout and Types

The following tables describe CN2 connector terminal layout and types.

■ CN2 Connector Terminal Layout

Pin	Signal	Function	Pin	Signal	Function
1	PG 5V	PG power supply +5V	2	PG 0V	PG power supply 0V
3	BAT (+)	Battery (+) (For an absolute encoder)	4	BAT (-)	Battery (-) (For an absolute encoder)
5	PS	PG serial signal input	6	/PS	PG serial signal input

■ CN2 Connector Models

Servo Amplifier Connectors	Applicable Plug (or Socket)		
	Soldered Plug (Servo Amplifier Connector)	Soldered Plug (Servomotor Connector)	Manufacturer
53460-0611	55100-0600 (Yaskawa number: JZSP-CMP9-1)	54280-0600 (Yaskawa number: JZSP-CMP9-2)	Molex Japan Co., Ltd.

Note: 1. FA1394 is the product number for the servo amplifier end plug and the servomotor end socket set from Molex Japan Co., Ltd.

2. The servomotor-end relay socket connects to the encoder connector for the SGMAH and SGMPH servomotor.

3. The following encoder connectors are for the SGMGH and SGMSH servomotor:

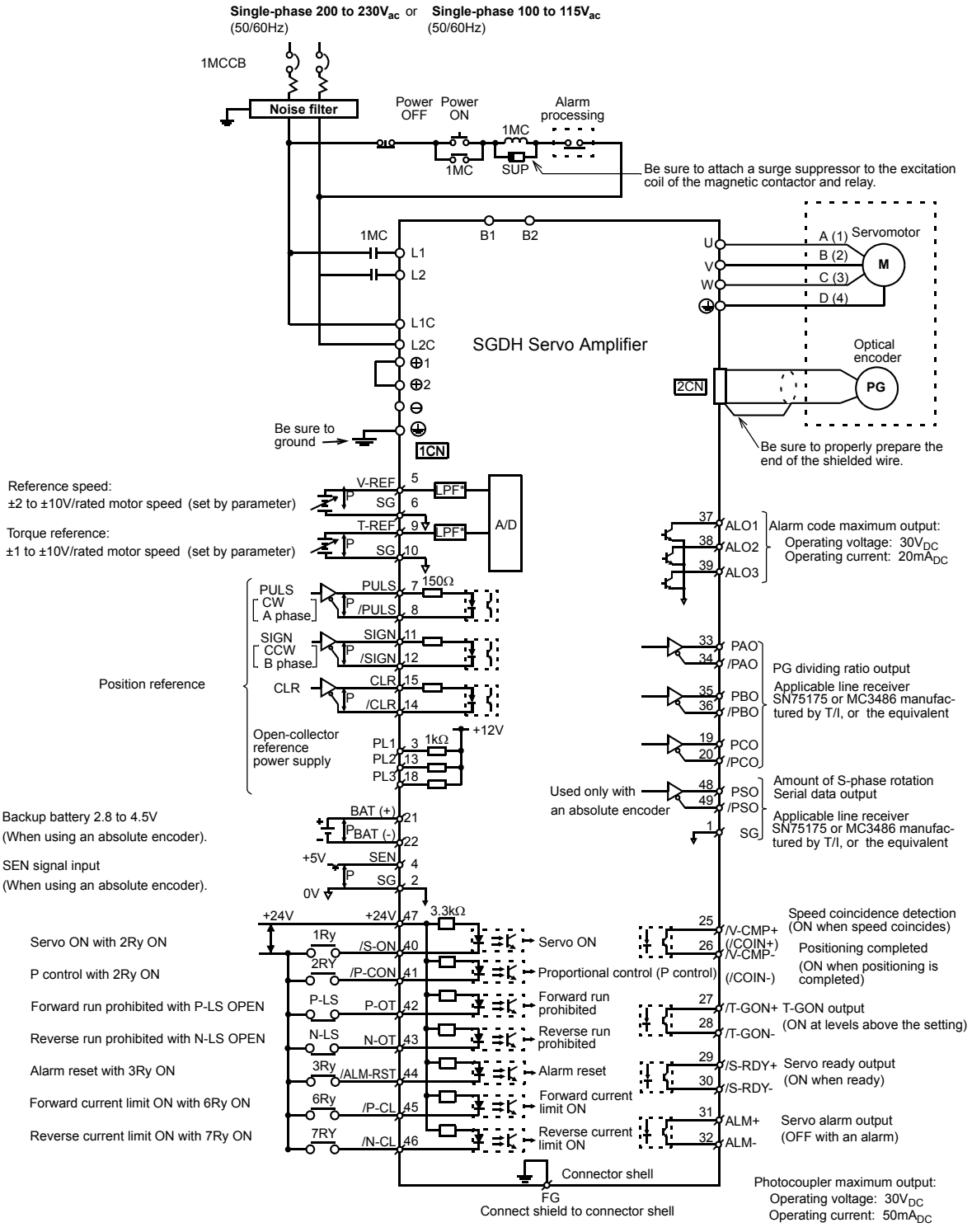
L-shaped plug: MS3108B20-29S
Straight: MS3106B20-29S
Cable clamp: MS3057-12A

Note: Encoder cables are available from Yaskawa. For more details on the cables, see *Sigma II Series Servo System Catalog Supplement (G-MI#99001).*

3.6 Examples of Standard Connections

The following diagrams show examples of standard servo amplifier connections by specifications and type of control.

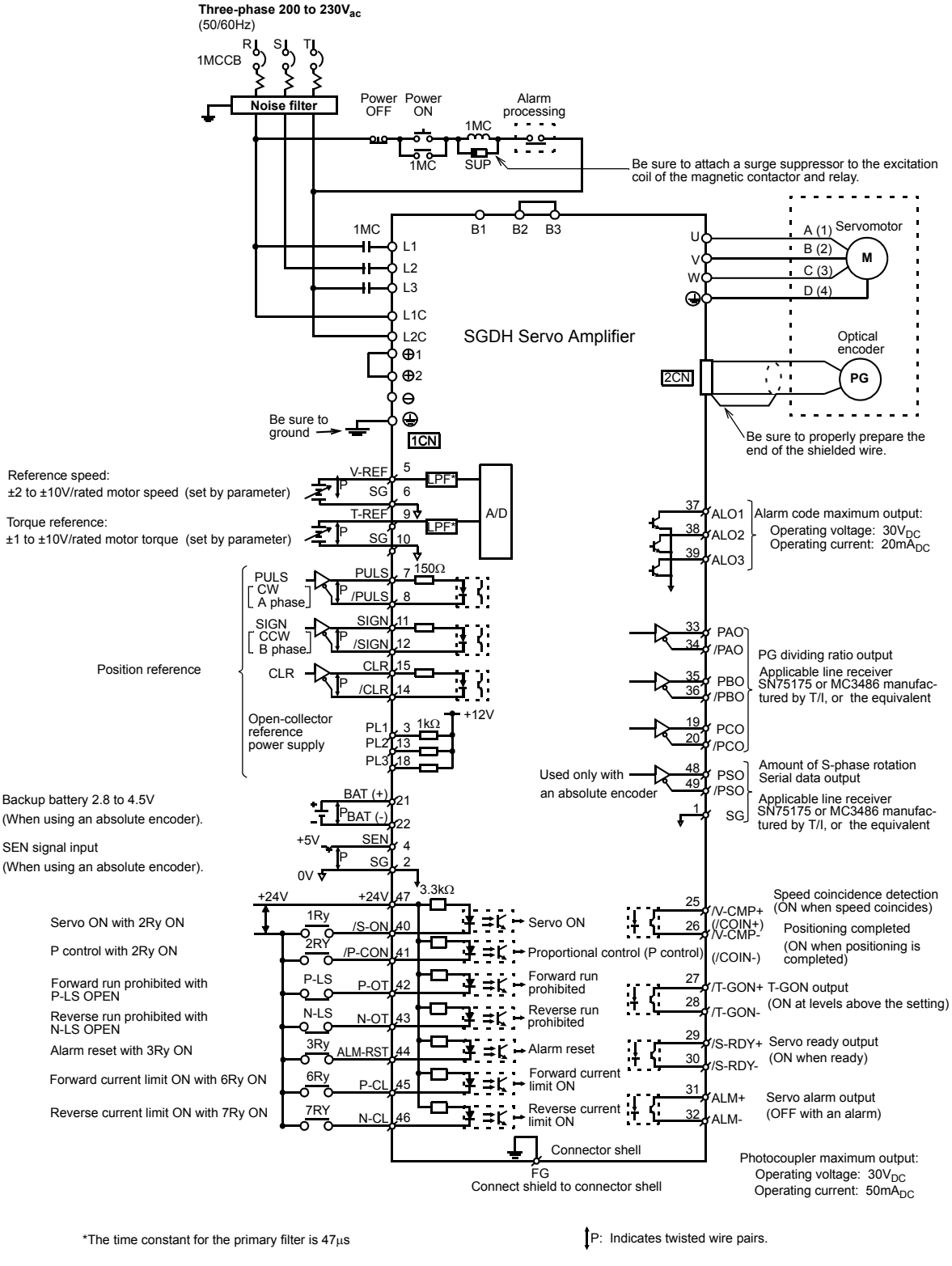
3.6.1 Single-Phase Power Supply Specifications



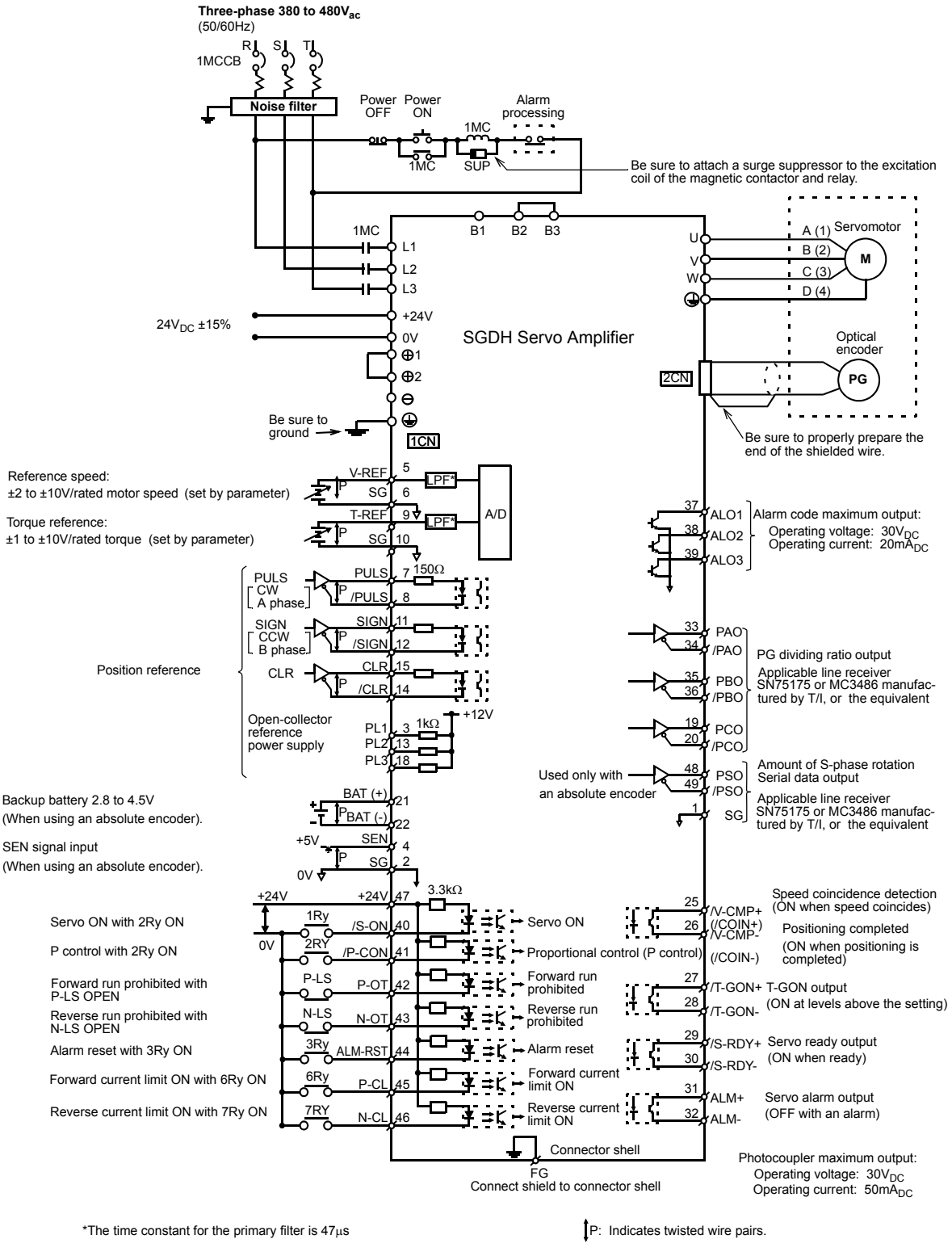
*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

3.6.2 Three-Phase Power Supply Specifications (200V)



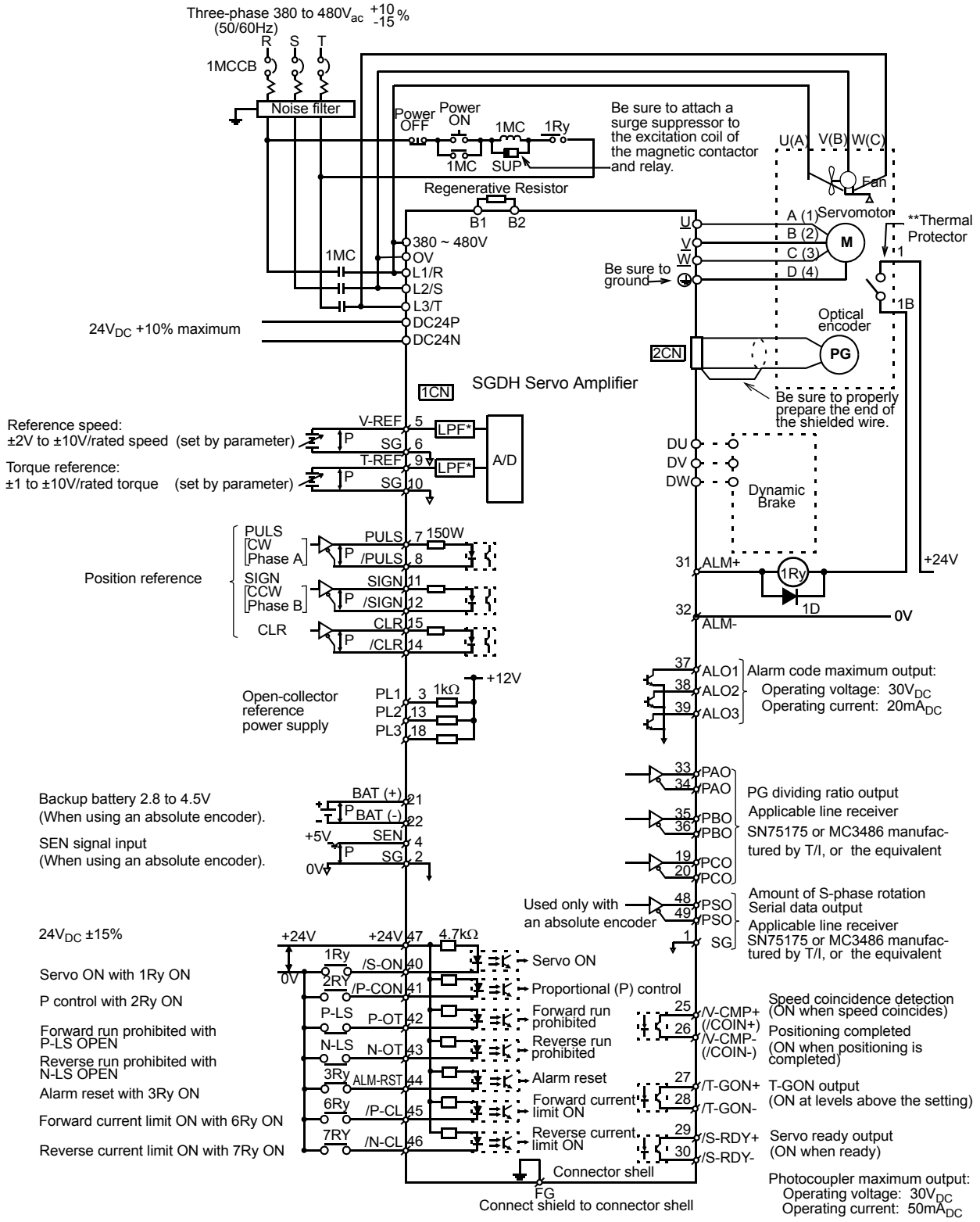
3.6.3 Three-Phase Power Supply Specifications (400V)



*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

400V (22kW, 30kW)

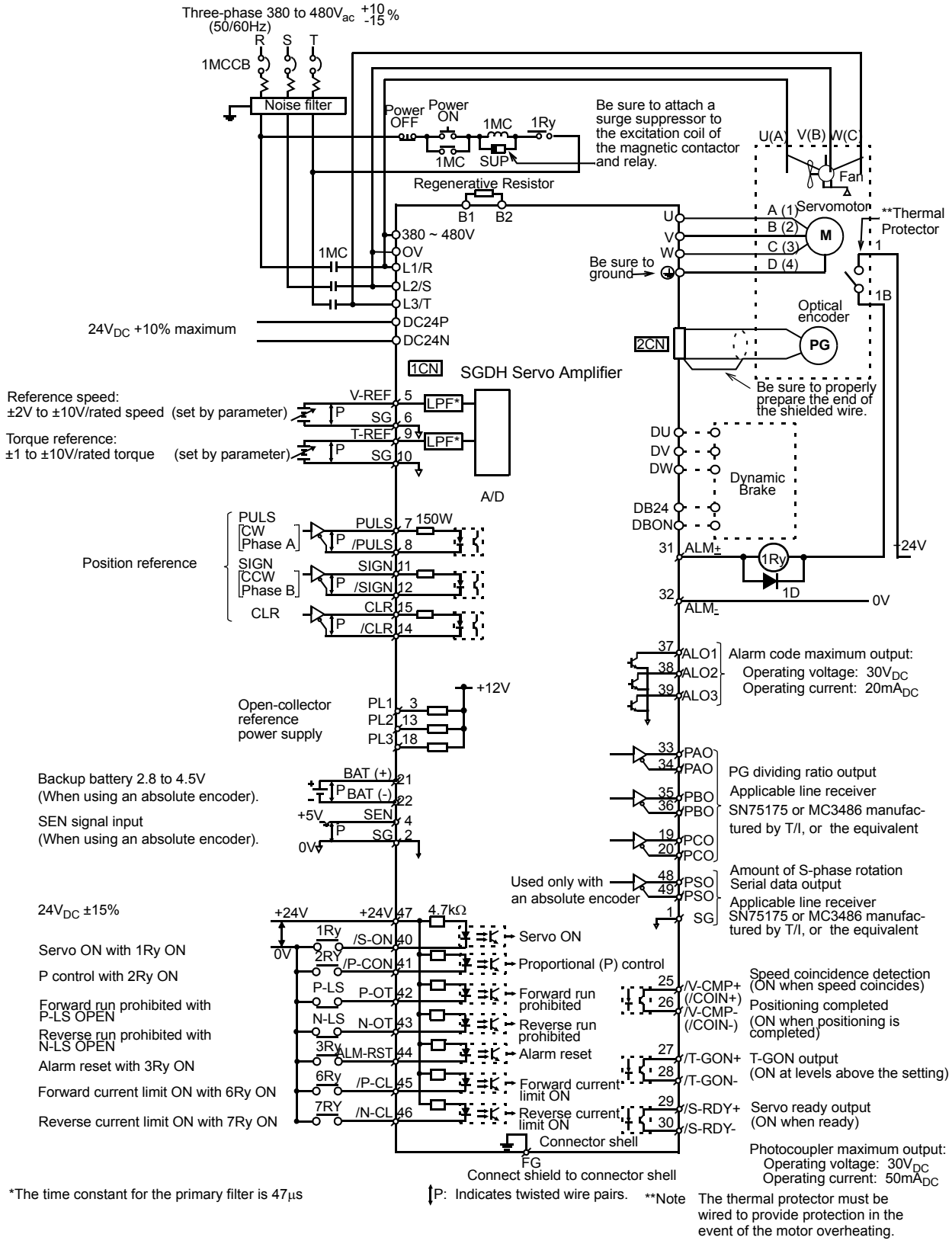


*The time constant for the primary filter is 47μs

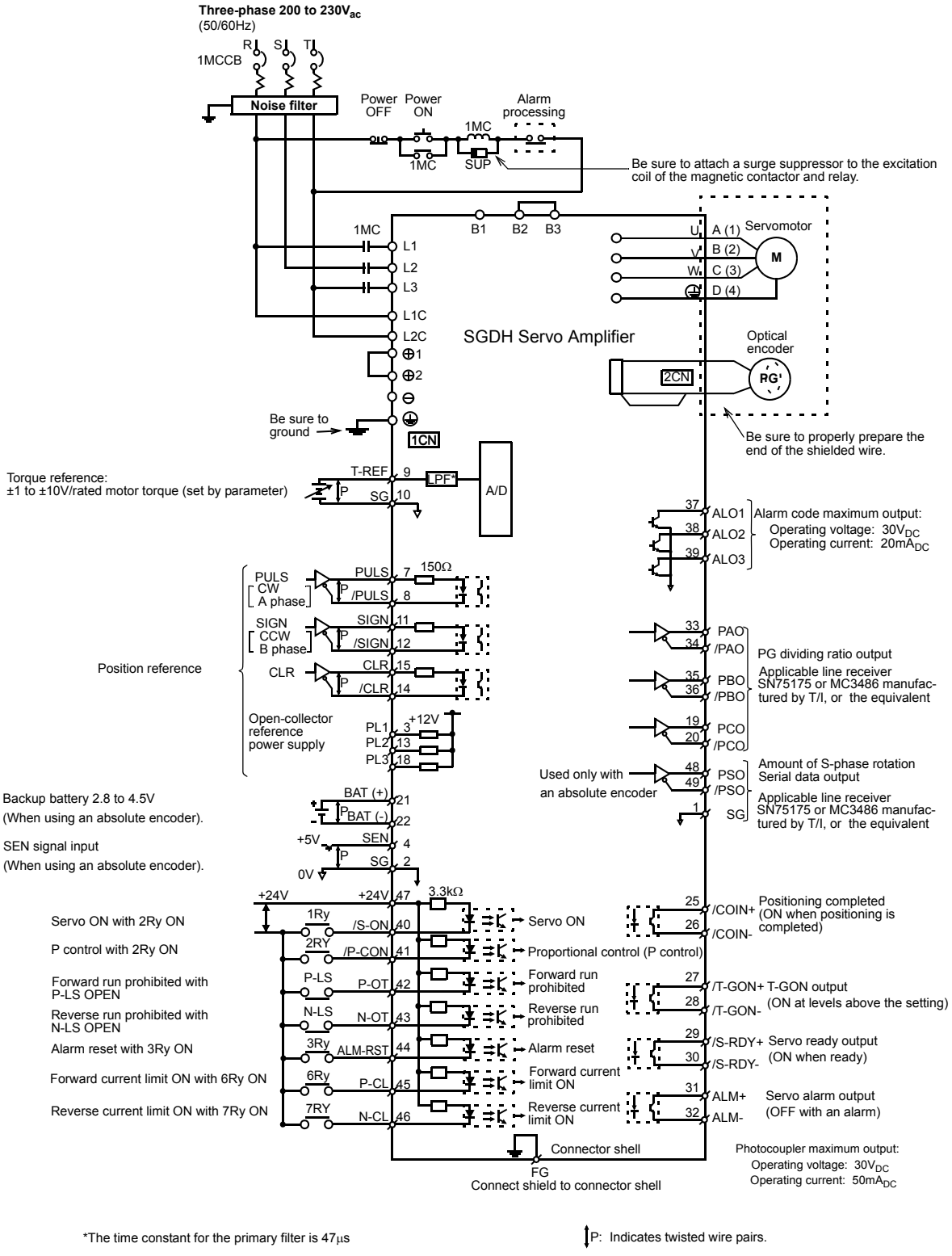
P: Indicates twisted wire pairs.

**Note The thermal protector must be wired to provide protection in the event of the motor overheating.

400V (37kW to 55kW)



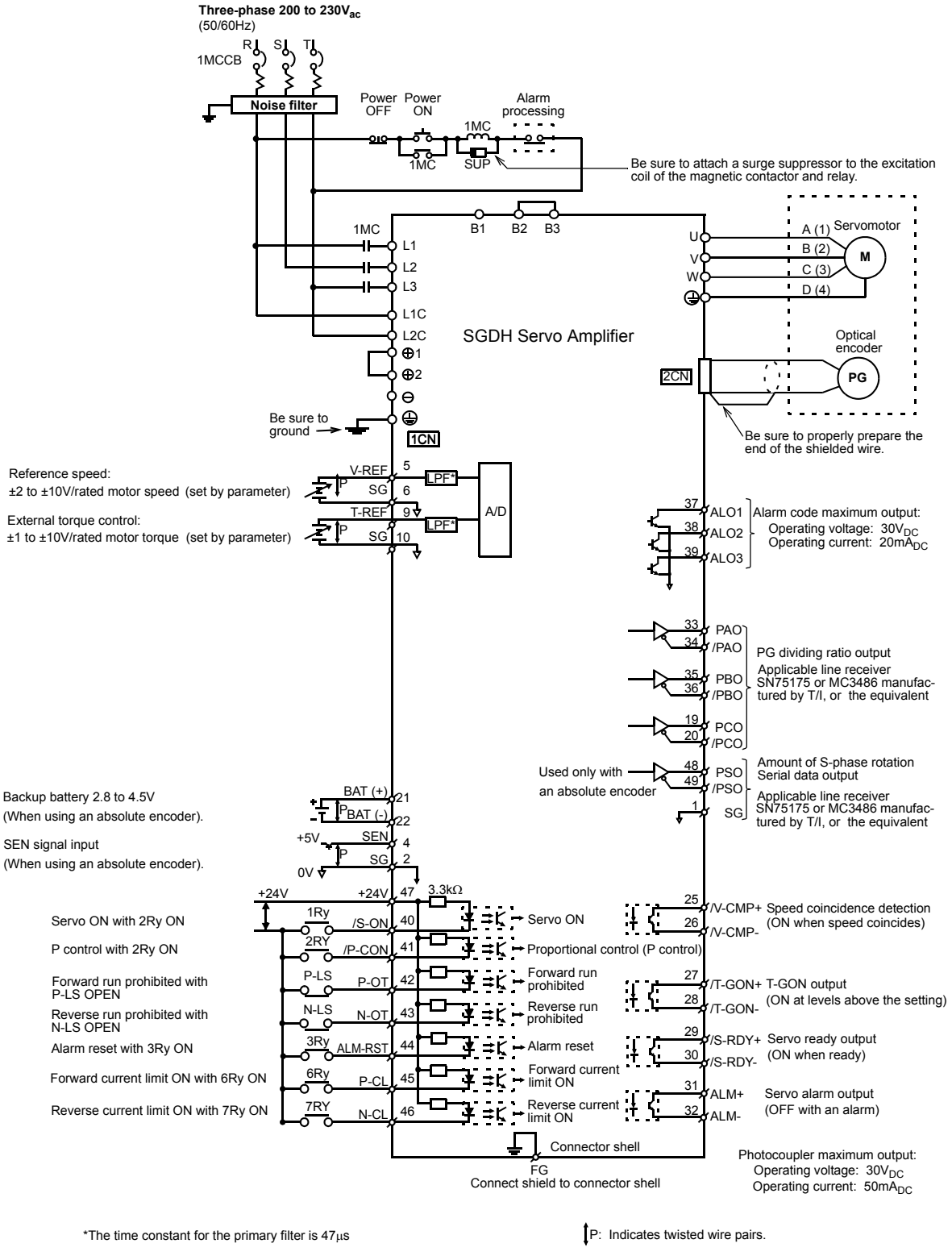
3.6.4 Position Control Mode



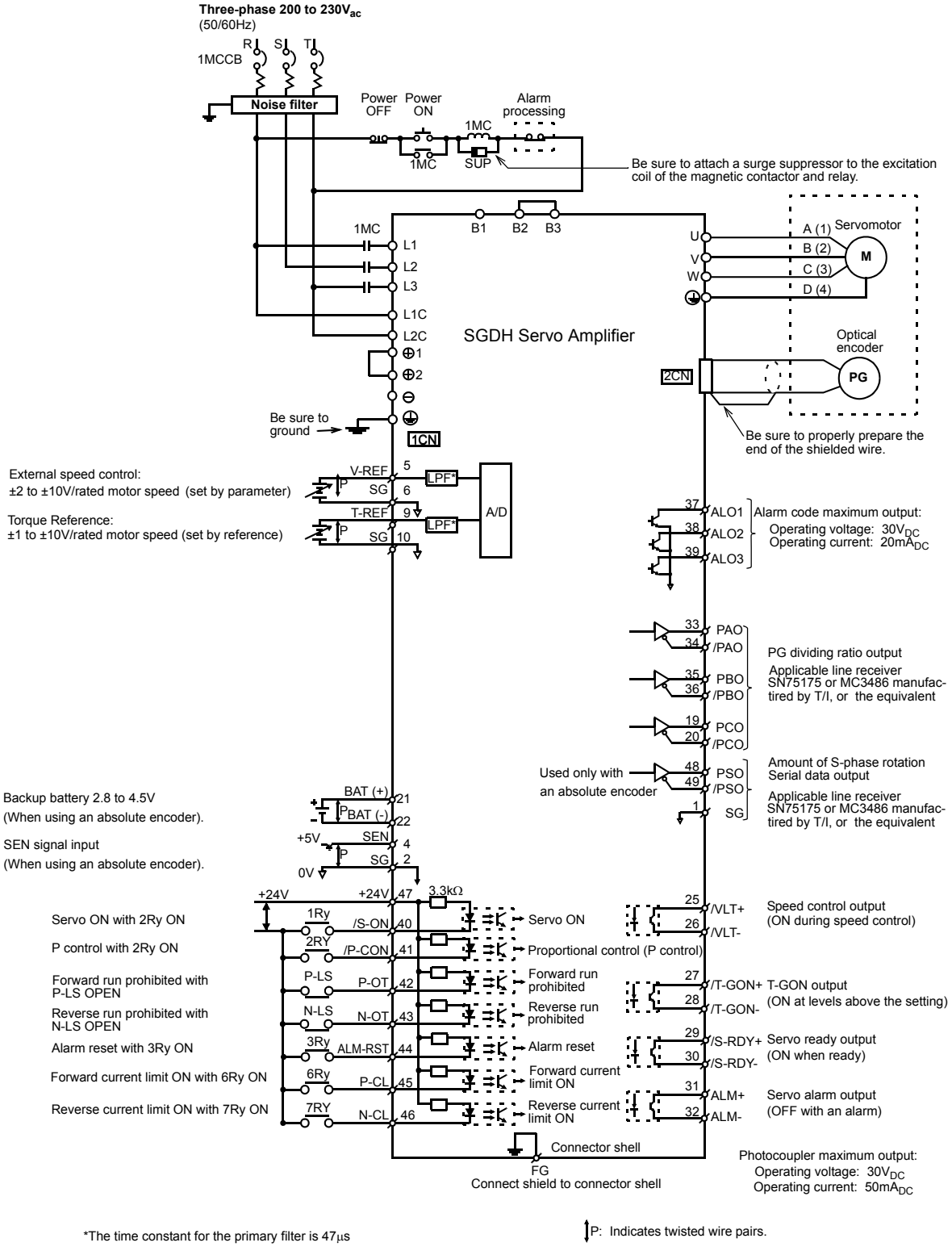
*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

3.6.5 Speed Control Mode



3.6.6 Torque Control Mode



*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

4 Trial Operation

This chapter describes a two-step trial operation. Be sure to complete step 1 before proceeding to step 2.

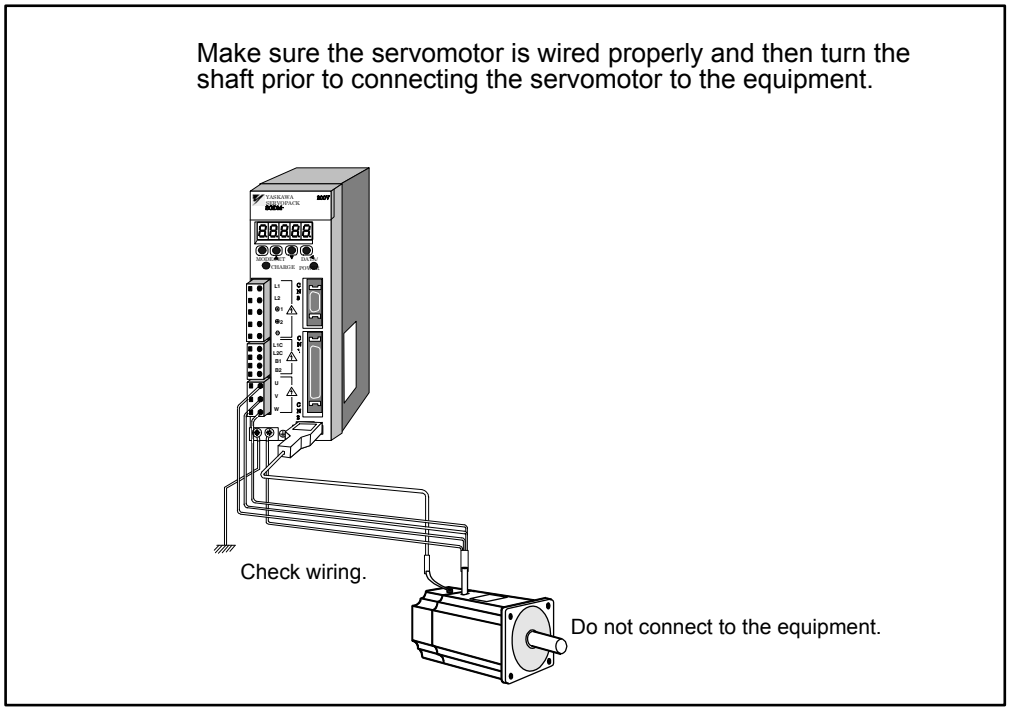
4.1 Two-Step Trial Operation 4-2
4.1.1 Step 1: Trial Operation for Servomotor without Load 4-3
4.1.2 Step 2: Trial Operation with the Servomotor Connected to a Load 4-9
4.2 Additional Setup Procedures in Trial Operation 4-10
4.2.1 Servomotors with Brakes 4-10
4.2.2 Position Control by Host Controller 4-12
4.3 Minimum Parameters and Input Signals 4-13
4.3.1 Parameters 4-13
4.3.2 Input Signals 4-13

4.1 Two-Step Trial Operation

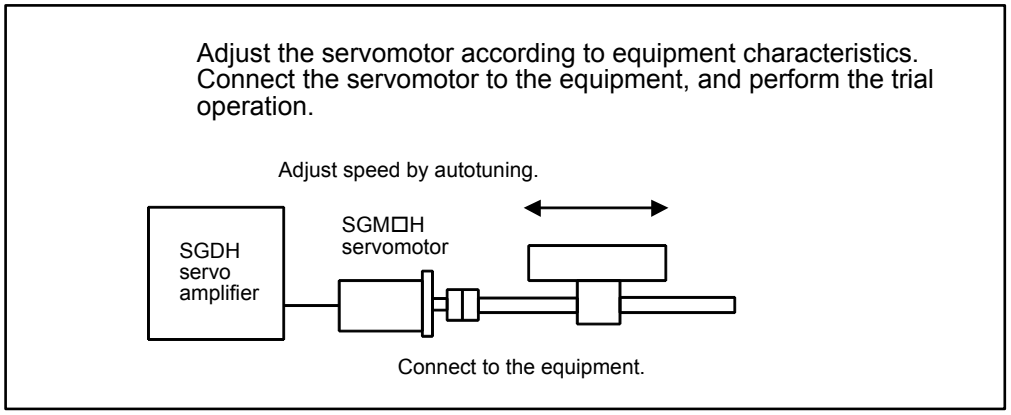
Make sure that all wiring is completed prior to starting trial operation.

Perform the trial operation in the order given below (step 1 and 2) for your safety. See *4.1.1 Step 1: Trial Operation for Servomotor without Load* and See *4.1.2 Step 2: Trial Operation with the Servomotor Connected to a Load* for more details on the trial operation.

Step 1: Trial Operation for Servomotor without Load


Make sure the servomotor is wired properly and then turn the shaft prior to connecting the servomotor to the equipment.
Check wiring.
Do not connect to the equipment.

Step 2: Trial Operation with the Equipment and Servomotor Connected


Adjust the servomotor according to equipment characteristics. Connect the servomotor to the equipment, and perform the trial operation.
Adjust speed by autotuning.
SGDH servo amplifier
SGM□H servomotor
Connect to the equipment.

4.1.1 Step 1: Trial Operation for Servomotor without Load

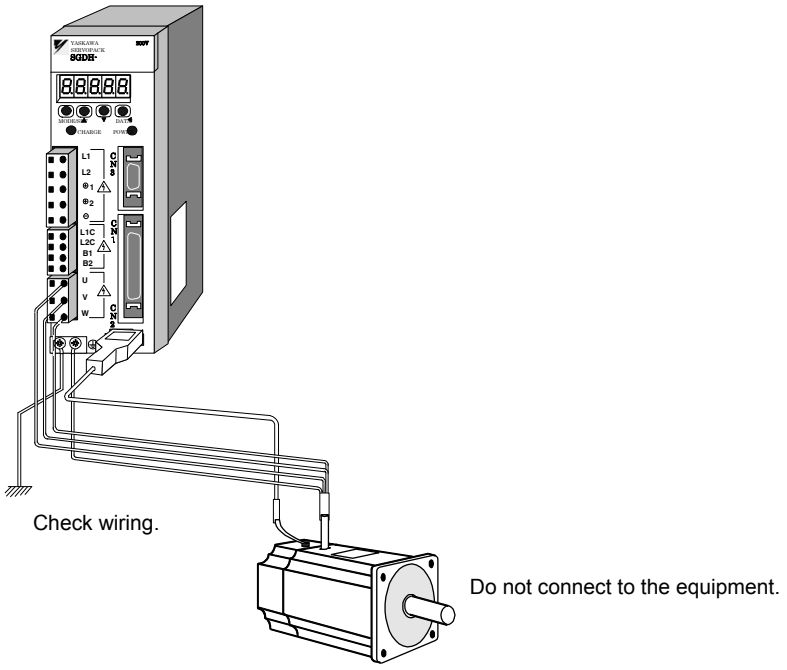
CAUTION

- **Do not operate the servomotor while it is connected to the equipment.**
  To prevent accidents, initially perform step 1 where the trial operation is conducted under no-load conditions (with all couplings and belts disconnected).

In step 1, make sure that the servomotor is wired properly as shown below. Incorrect wiring is generally the reason why servomotors fail to operate properly during trial operation.

- Check main power supply circuit wiring.
- Check servomotor wiring.
- Check CN1 I/O signal wiring.

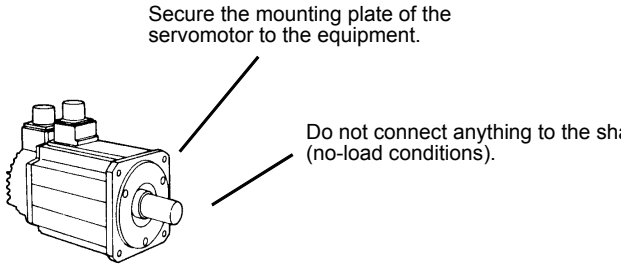
Make sure the host controller and other adjustments are completed as much as possible in step 1 (prior to connecting the servomotor to equipment).



Note Check the items on the following pages in the order given during the servomotor trial operation.

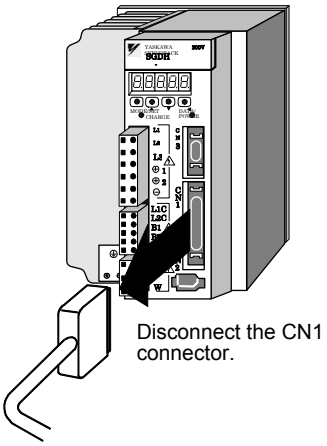
See *4.2.1 Servomotors with Brakes*, if you are using a servomotor with brakes.

1. Secure the servomotor.



Secure the servomotor mounting plate to the equipment in order to prevent the servomotor from moving during operation.

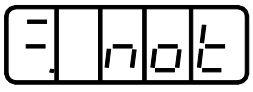
2. Check the wiring.



Disconnect the CN1 connector and check servomotor wiring in the power supply circuit. The CN1 I/O signals are not used, so leave the connector disconnected.

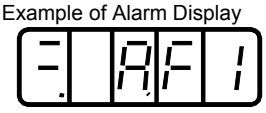
3. Turn ON power.

Normal display



Alternate display

Example of Alarm Display

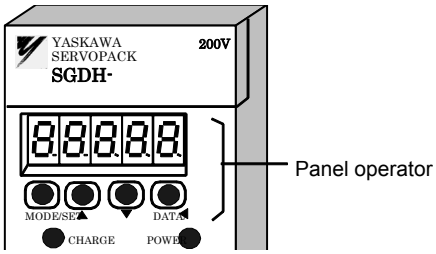


Turn ON servo amplifier power. If the servo amplifier has turned ON normally, the LED display on the front panel of the servo amplifier will appear as shown above. Power is not supplied to the servomotor because the servo is OFF.

If an alarm display appears on the LED indicator as shown above, the power supply circuit, servomotor wiring, or encoder wiring is incorrect. In this case, turn OFF power and take appropriate action. See *9.2 Troubleshooting*.

Note If an absolute encoder is used, it must be set up. Refer to *5.7.4 Absolute Encoder Setup.*

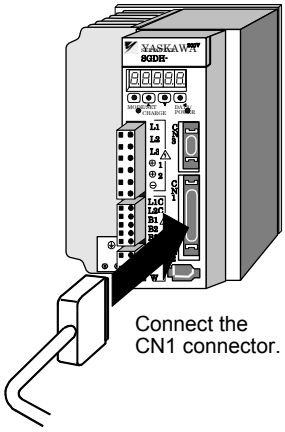
4. Operate with the panel operator.



Operate the servomotor using the panel operator. Check to see if the servomotor runs normally.

See *7.2.2 JOG Operation Using the Digital Operator* for more details on the procedure.

5. Connect the signal lines.



Use the following procedure to connect the CN1 connector.

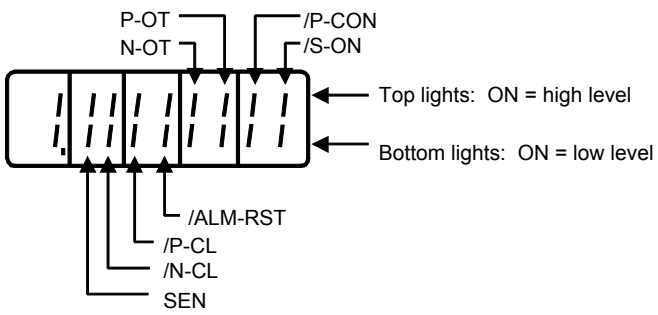
a) Turn OFF power.
b) Connect the CN1 connector.
c) Turn ON power again.

6. Check the input signals.

Check input signal wiring in Monitor Mode using the panel operator. See *7.1.7 Operation in Monitor Mode* for more details on the procedure.

Turn ON and OFF each signal line to see if the LED monitor bit display on the panel changes as shown below.

Input signal LED display



Input Signal Status	LED Display
OFF (high level)	Top LED indicators light.
ON (low level)	Bottom LED indicators light.

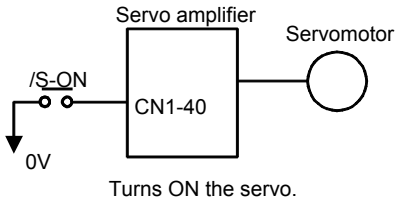
Note: The servomotor will not operate properly if the following signal lines are not wired correctly. Always wire them correctly. Short the signal lines if they will be unused. The input signal selections (parameters Pn50A to Pn50D) can be used to eliminate the need for external short circuiting.

Signal Symbol	Connector Pin Number	Description
P-OT	CN1-42	The servomotor can rotate in the forward direction when this signal line is low (0V).
N-OT	CN1-43	The servomotor can rotate in the reverse direction when this signal line is low (0V).
/S-ON	CN1-40	The servomotor is turned ON when this signal line is low (0V). Leave the servomotor OFF.
+24VIN	CN1-47	Control power supply terminal for sequence signals.

Note: IF an absolute encoder is being used, the servo will not turn ON when the servo ON signal (/S-ON) is input unless the SEN signal is also ON.

When the SEN signal is checked in monitor mode, the top of the LED will light because the SEN signal is high when ON.

7. Turn ON the servo.



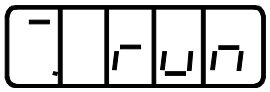
Turn ON the servo using the following procedure.

a. Make sure there are no reference signals input.

- Set V-REF (CN1-5) and T-REF (CN1-9) to 0V for speed and torque control.
- Set PULS (CN1-7) and SIGN (CN1-11) to low for position control.

b. Turn ON the servo ON signal.

Display with the servo ON.



Set /S-ON (CN1-40) to 0V. If normal, the servomotor will turn ON and the LED indicator on the front panel will display as shown above. If an alarm display appears, take appropriate action as described in *9.2 Troubleshooting.*

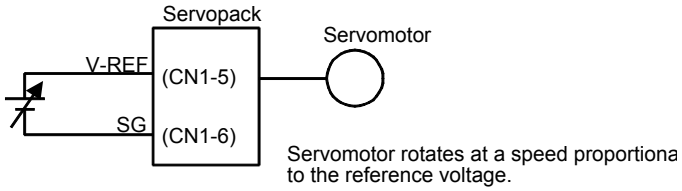
Note: If there is noise in the reference voltage for speed control, the "-" on the left of the 7-segment LED may flash.

■ Operating Using Reference Input

The operating procedure here depends on the parameter settings (control mode selection at memory switch Pn000.1). Use the following procedure for operations with speed and position control.

Operating Procedure in Speed Control Mode: Set Pn000.1 to 0

Standard speed control setting is described here.



1. Gradually increase the reference speed input (V-REF, CN1-5) voltage. The servomotor will rotate.

2. Check the following items in Monitor Mode. See *7.1.7 Operation in Monitor Mode.*

Un000	Actual motor speed
Un001	Reference speed

- Has the reference speed been input?
- Is the motor speed as designed?
- Does the reference speed coincide with the actual motor speed?
- Does the servomotor stop when the speed reference is 0?

3. If the servomotor rotates at extremely slow speed with 0V specified for the reference voltage, correct the reference offset value as described in *7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset* or *7.2.4 Manual Adjustment of the Speed and Torque Reference Offset.*

4. Reset the following parameters to change the motor speed or direction of rotation.

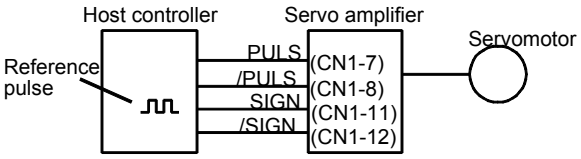
Pn300	Sets the reference speed input gain See *5.2.1 Speed Reference.*
Pn000.0	Selects the rotation direction. See *5.1.1 Switching Servomotor Rotation Direction.*

Operating Procedure In Position Control Mode: Set Pn000.1 to 1

1. Set the parameter Pn200.0 so the reference pulse form is the same as the host controller output form.

   Selecting the reference pulse form: See *5.2.2 Position Reference.*

2. Input a slow speed pulse from the host controller and execute low-speed operation.



3. Check the following data in Monitor Mode. See *7.1.7 Operation in Monitor Mode.*

Un000	Actual motor speed
Un007	Reference pulse speed display
Un008	Position offset

   - Has the reference pulse been input?
   - Is the motor speed as designed?
   - Does the reference speed coincide with the actual motor speed?
   - Does the servomotor stop when the speed reference is 0?

4. Reset the parameters shown below to change the motor speed or direction of rotation.

Pn202, Pn203	Electronic gear ratio See *5.2.5 Using the Electronic Gear Function.*
Pn000.0	Selects the direction of rotation. See *5.1.1 Switching Servomotor Rotation Direction.*

   If an alarm occurs or the servomotor fails to operate during the above operation, CN1 connector wiring is incorrect or parameter settings do not match the host controller specifications. Check the wiring and review the parameter settings, then repeat step 1.

Note: References
- List of alarms: *See 9.2.3 Alarm Display Table.*
- List of parameters: See *Appendix B List of Parameters.*

4.1.2 Step 2: Trial Operation with the Servomotor Connected to a Load

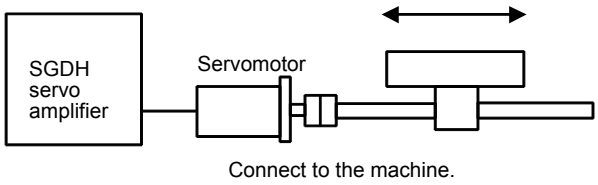
⚠ WARNING

Follow the procedure below for step 2 operation precisely as given.
Malfunctions that occur after the servomotor is connected to the equipment not only damage the equipment, but may also cause an accident resulting in death or injury.

Before proceeding to step 2, repeat step 1 (servomotor trial operation without a load) until all concerns including parameters and wiring have fully satisfied expectations.

After step 1 has been completed, proceed to step 2 for trial operation with the servomotor connected to the equipment. The servo amplifier is now adjusted in the following ways to meet the specific equipment's characteristics.

- Using autotuning to match the servo amplifier to the equipment's characteristics.
- Matching the direction of rotation and speed to the equipment's specifications.
- Checking the final control form.



Follow the procedures below to perform the trial operation.

1. Make sure power is OFF.
2. Connect the servomotor to the equipment.
   See *2.1 Servomotors* for more details on connecting the servomotor.
3. Use autotuning to match the servo amplifier to equipment characteristics.
   See *6.3 Auto-Tuning*.
4. Operate the servomotor by reference input.

   As in step 1 (*Servomotor Trial Operation without Load*), execute operation by reference input as described in *4.1.1 Step 1: Trial Operation for Servomotor without Load.* Tune to match the host controller at this time, as well.
5. Set and record user settings.
   Set parameters as required and record all settings for use later in maintenance.

Note: The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of time after the trial operation has been completed to ensure that it is properly broken in.

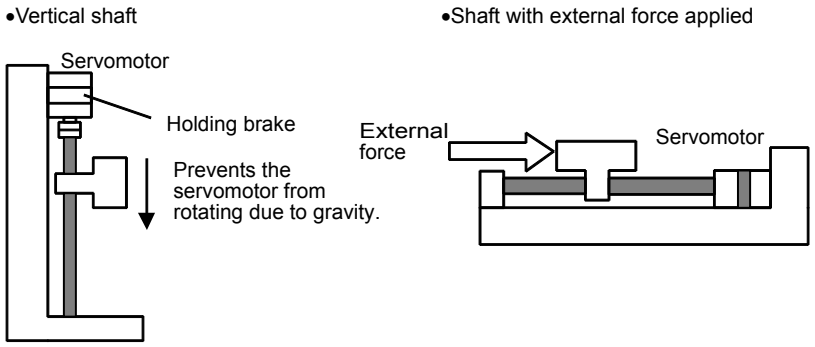
4.2 Additional Setup Procedures in Trial Operation

Before starting trial operation, precautionary setup procedures must be followed when either of two equipment configurations are used. These are delineated in the two subsequent sections.

4.2.1 Servomotors with Brakes

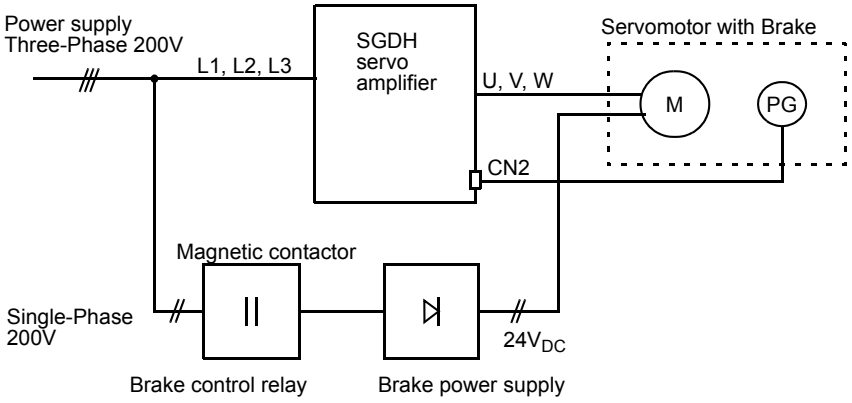
Use a servomotor with a brake for vertical shaft applications or when external force must be applied to the shaft to prevent rotation due to gravity or external force during a power loss.

The servo amplifier uses the brake interlock output (/BK) signal to control the holding brake operation when using servomotors with brakes.



Note: To prevent faulty operation due to gravity or external force, first make sure that both the servomotor and holding brake work properly when . When assured that each operates properly, connect the servomotor to the rest of the equipment to start the trial operation.

The following figure shows wiring for a servomotor with brakes. See *5.4.4 Using the Holding Brake* for details on wiring.



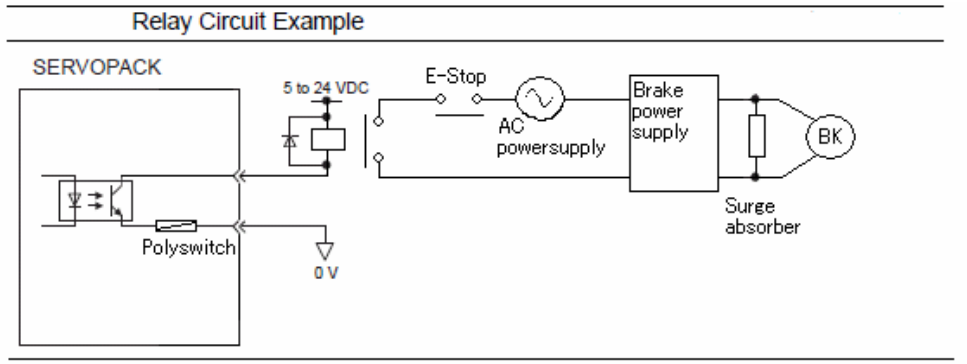
Holding brakes are generally used for vertical load applications or when an external force must be applied to the shaft to prevent rotation due to gravity or another external force. Incorrect wiring or application of abnormal voltage to the servo amplifier output may cause damage to the amplifier and/or the machine. Therefore,

care must be exercised when wiring the holding brake circuit. Please observe the following precautions and check the brake circuit wiring carefully.

Caution
• Faulty wiring or abnormal voltage may cause short-circuit failure in the output circuit of the servo amplifier • Short-circuit failure of the brake signal (/BK) could cause machine break-down and/or physical injury. • Check the wiring and perform trial runs with caution, especially with vertical load applications, and be sure to follow appropriate safety procedures

Addition of an outside interlock:

Safety can be enhanced by the addition of an interlock circuit.
Please examine the operation sequence of the emergency stop circuit in accordance with your system requirements. Asuggested interlock circuit is shown below:

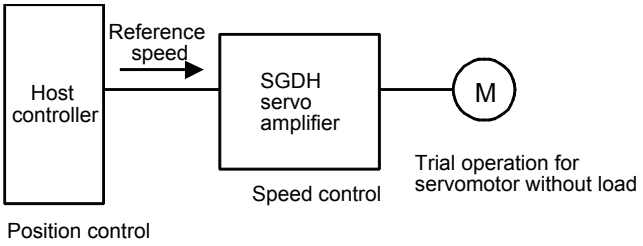


Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows:

- Voltage: 30 VDC
- Current: 50 mA DC

4.2.2 Position Control by Host Controller

If the position control algorithm of the host controller has not been established or finalized, disconnect the servomotor from the equipment before performing a trial operation. This will prevent the servomotor from running out of control and damaging the equipment.



Check servomotor operation as described in the following table.

Controller Reference	Check	Procedure	Description
JOG Operation (Constant Reference Speed Input from Host Controller)	Motor speed	Check motor speed as follows: • Use the speed monitor (Un000) on the panel operator. • Run the servomotor at low speed. Input a reference speed of 60rpm, for example, to see if the servomotor makes one revolution per second.	Check the parameter setting at Pn300 to see if the reference speed gain is correct.
Simple Positioning	Number of motor rotations	Input a reference equivalent to one servomotor rotation and visually check to see if the shaft makes one revolution.	Check the parameter setting at Pn201 to see if the number of dividing pulses is correct.
Overtravel (P-OT and N-OT Used)	Whether the servo-motor stops rotating when P-OT and N-OT signals are applied	Check to see if the servomotor stops when P-OT and N-OT signals are input during continuous servomotor operation.	Review P-OT and N-OT wiring if the servomotor does not stop.

4.3 Minimum Parameters and Input Signals

This section of this manual describes the minimum parameters and input signals required for trial operation.

4.3.1 Parameters

See *7.1.6 Operation in Parameter Setting Mode* for more details on setting parameters.

Turn OFF power once after changing any parameter except Pn300. The change will not be valid until power is restored.

Basic Parameters

Pn000.1	Function Selection Basic Switches: Control Mode Selection	See *5.3.5*

Speed Control

Pn300	Speed Reference	See *5.2.1*
Pn201	Using the Encoder Signal Output	See *5.2.3*

Position Control

Pn200.0	Position Reference	See *5.2.2*
Pn202	Using the Electronic Gear Function (Numerator)	See *5.2.5*
Pn203	Using the Electronic Gear Function (Denominator)	See *5.2.5*

Changing Servomotor Rotation Direction

The wiring may be incorrect if the specified direction differs from the actual direction of rotation. Recheck the wiring and correct if necessary. Use the following parameter to reverse the direction of rotation.

Pn000.0	Switching Servomotor Rotation Direction	See *5.1.1*

4.3.2 Input Signals

Input signal selection settings through parameters can be used to eliminate the need for external short circuits.

Signal Name		Pin Number	Description
/S-ON	Servo ON	CN1-40	See *5.5.2 f*or more details on turning ON and OFF the servomotor.

Signal Name		Pin Number	Description
P-OT	Forward run prohibited	CN1-42	See *5.1.2* for more details on the overtravel limit switch.
N-OT	Reverse run prohibited	CN1-43	

5 Parameter Settings and Functions

This chapter describes the procedure for setting and applying parameters.

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■ Before Reading this Chapter

This chapter describes the use of each CN1 connector I/O signals in the SGDH servo amplifier as well as the procedure for setting the related parameters for the intended purposes.

The following sections can be used as references for this chapter.

- List of CN1 I/O signals: See *3.4.3 I/O Signal Names and Functions.*
- CN1 I/O signal terminal layout: See *3.4.2 List of CN1 Terminals.*
- List of parameters: See *Appendix B List of Parameters.*
- Parameter setting procedure: See *7.1.6 Operation in Parameter Setting Mode*

The CN1 connector is used to exchange signals with the host controller and external circuits.

■ Parameter Configurations

Parameters are comprised of the types shown in the following table. See *Appendix B List of Parameters.*

Type	Parameter Number	Description
Function Selection Constants	Pn000 to Pn003	Select basic and application functions such as the type of control or the stop mode used when an alarm occurs.
Servo Gain and Other Constants	Pn100 to Pn123	Set numerical values such as speed and position loop gains.
Position Control Constants	Pn200 to Pn208	Set position control parameters such as the reference pulse input form and gear ratio.
Speed Control Constants	Pn300 to Pn308	Set speed control parameters such as speed reference input gain and soft start deceleration time.
Torque Control Constants	Pn400 to Pn409	Set torque control parameters such as the torque reference input gain and forward/reverse torque limits.
Sequence Constants	Pn500 to Pn512	Set output conditions for all sequence signals and changes I/O signal selections and allocations.
Others	Pn600 to Pn601	Specify the capacity for an external regenerative resistor and reserved constants.
Auxiliary Function Execution	Fn000 to Fn014	Execute auxiliary functions such as JOG Mode operation.
Monitor Modes	Un000 to Un00D	Enable speed and torque reference monitoring, as well as monitoring to check whether I/O signals are ON or OFF.

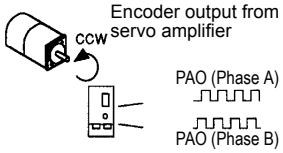
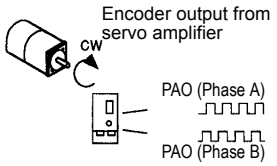
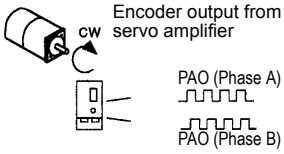
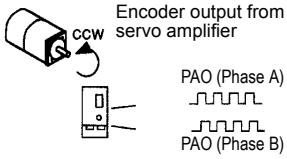
5.1 Settings According to Device Characteristics

This section describes the procedure for setting parameters according to the dimensions and performance characteristics of the equipment used.

5.1.1 Switching Servomotor Rotation Direction

The servo amplifier has a Reverse Rotation Mode that reverses the direction of servomotor rotation without rewiring. Forward rotation in the standard setting is defined as counterclockwise as viewed from the load.

With the Reverse Rotation Mode, the direction of servomotor rotation can be reversed without changing other parameters. Only the direction (+, –) of shaft motion is reversed.

	Standard Setting	**Reverse Rotation Mode**
Forward Reference		
Reverse Reference		

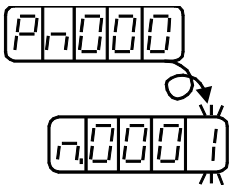
■ Setting Reverse Rotation Mode

Use the parameter Pn000.0.

Parameter	Signal	Setting	Control Mode
Pn000.0	Direction Selection	Default Setting: 0	Speed/Torque Control, Position Control

Use the following settings to select the direction of servomotor rotation.

Setting	Description	
0	Forward rotation is defined as counterclockwise (CCW) rotation as viewed from the load.	(Standard setting)
1	Forward rotation is defined as clockwise (CW) rotation as viewed from the load.	(Reverse Rotation Mode)



5.1.2 Setting the Overtravel Limit Function

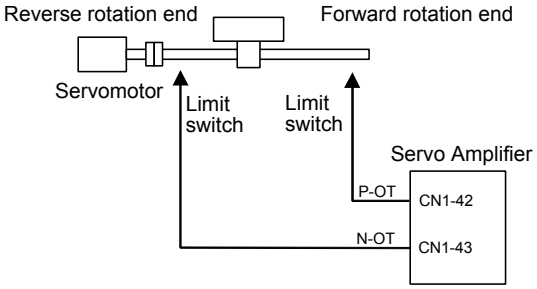
The overtravel limit function forces movable equipment parts to stop if they exceed the allowable range of motion.

■ Using the Overtravel Function

To use the overtravel function, connect the overtravel limit switch input signal terminals shown below to the correct pins of the servo amplifier CN1 connector.

Input P-OT CN1-42	Forward Run Prohibited (Forward Overtravel)	Speed/Torque Control, Position Control
Input N-OT CN1-43	Reverse Run Prohibited (Reverse Overtravel)	Speed/Torque Control, Position Control

Connect limit switches as shown below to prevent damage to the devices during linear motion.



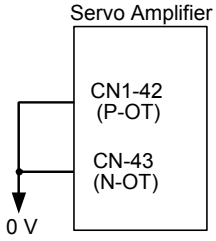
Drive status with an input signal ON or OFF is shown in the following table.

Signal	State	Input Level	Description
P-OT	ON	CN1-42: low	Forward rotation allowed, (normal operation status).
	OFF	CN1-42: high	Forward run prohibited (reverse rotation allowed).
N-OT	ON	CN1-43: low	Reverse rotation allowed, (normal operation status).
	OFF	CN1-43: high	Reverse run prohibited (forward rotation allowed).

■ Enabling/Disabling Input Signals

Set the following parameters to specify whether input signals are used for overtravel or not. The default setting is "used."

Parameter	Signal	Setting	Control Mode
Pn50A.3	P-OT Signal Mapping (Forward Run Prohibit Input Signal)	Default Setting: 2	Speed/Torque Control, Position Control
Pn50B.0	N-OT Signal Mapping (Reverse Run Prohibit Input Signal)	Default Setting: 3	Speed/Torque Control, Position Control



The short-circuit wiring shown in the figure can be omitted when P-OT and N-OT are not used.

Parameter	Signal	Setting	Description
Pn50A.3	P-OT Signal Mapping (Forward Run Prohibit Input Signal)	Default Setting: 2	Uses the P-OT input signal to prevent forward rotation. (Forward rotation is prohibited when CN1-42 is open and is allowed when CN1-42 is at 0V).
		8	Does not use the P-OT input signal to prevent forward rotation. (Forward rotation is always allowed and has the same effect as shorting CN1-42 to 0V).
Pn50B.0	N-OT Signal Mapping (Reverse Run Prohibit Input Signal)	Default Setting: 3	Uses the N-OT input signal to prevent reverse rotation. (Reverse rotation is prohibited when CN1-43 is open and is allowed when CN1-43 is at 0V).
		8	Does not use the N-OT input signal to prevent reverse rotation. (Reverse rotation is always allowed and has the same effect as shorting CN1-43 to 0V).

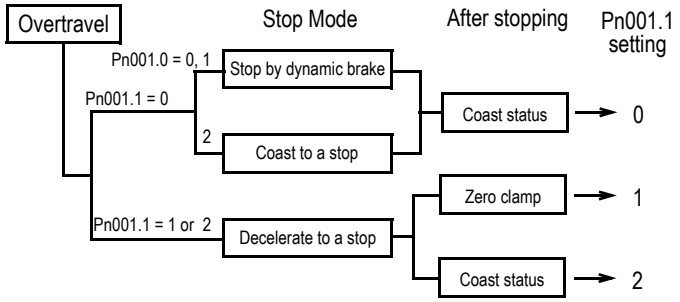
■ Servomotor Stop Mode for P-OT and N-OT Input Signals

Set the following parameters to specify the Servomotor Stop Mode when P-OT and N-OT input signals are used.

Specify the Servomotor Stop Mode when either of the following signals is input during servomotor operation.

- Forward run prohibited input (P-OT,CN1-42)
- Reverse run prohibited input (N-OT,CN1-43)

Parameter	Signal	Setting	Control Mode
Pn001.1	Overtravel Stop Mode	Default Setting: 0	Speed/Torque Control, Position Control



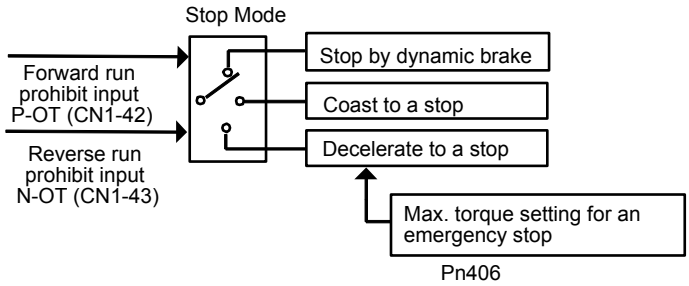
Note: For torque control, the servomotor will be placed in coast status after either decelerating or coasting to a stop (according to the stop mode set in Pn001.0), regardless of the setting of Pn001.1.

Parameter	Signal	Setting	Description
Pn001.1	Overtravel Stop Mode	0	Stops the servomotor the same way as turning the servo OFF (according to Pn001.0).
		1	Decelerates the servomotor to a stop at the preset torque, and then locks the servomotor in Zero Clamp Mode. Torque setting: Pn406 Emergency Stop Torque
		2	Decelerates the servomotor to a stop at the preset torque, and puts the servomotor in coast status. Torque setting: Pn406 Emergency Stop Torque

Pn406 specifies the stop torque applied for overtravel when the input signal for prohibiting forward or reverse rotation is used.

The torque limit is specified as a percentage of rated torque.

Parameter	Signal	Setting (%)	Control Mode
Pn406	Emergency Stop Torque (Valid when Pn001.1 is 1 or 2)	Range: 0% to Maximum Torque Default Setting: 800	Speed/Torque Control, Position Control


Stop Mode
Forward run prohibit input P-OT (CN1-42)
Reverse run prohibit input N-OT (CN1-43)
Stop by dynamic brake
Coast to a stop
Decelerate to a stop
Max. torque setting for an emergency stop
Pn406

5.1.3 Limiting Torque

The SGDH servo amplifier limits torque as follows:

- Level 1: Limits maximum output torque to protect the equipment or workpiece.
- Level 2: Limits torque after the servomotor moves the equipment to a specified position (internal torque limit).
- Level 3: Always limits output torque rather than speed.
- Level 4: Switches between speed and torque limit.

Application of levels 1 and 2 in the torque limit function are described below.

■ Setting Level 1: Internal Torque Limits

Maximum torque is limited to the values set in the following parameters.

Parameter	Signal	Setting (%)	Control Mode
Pn402	Forward Torque Limit	Range: 0 to 800 Default Setting: 800	Speed/Torque Control, Position Control
Pn403	Reverse Torque Limit	Range: 0 to 800 Default Setting: 800	Speed/Torque Control, Position Control

Sets the maximum torque limits for forward and reverse rotation.

Used when torque must be limited due to equipment conditions.

The torque limit function always monitors torque and outputs the signals below when the limit is reached.

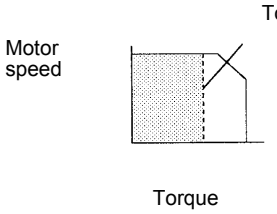
The following signals are output by the torque limit function.

Signal	Description
/CLT	Generated when Pn50F.0 allocates an output terminal from SO1 to SO3.
Monitor Mode (Un006)	Output signal monitor

The torque limits are specified as a percentage of the rated torque.

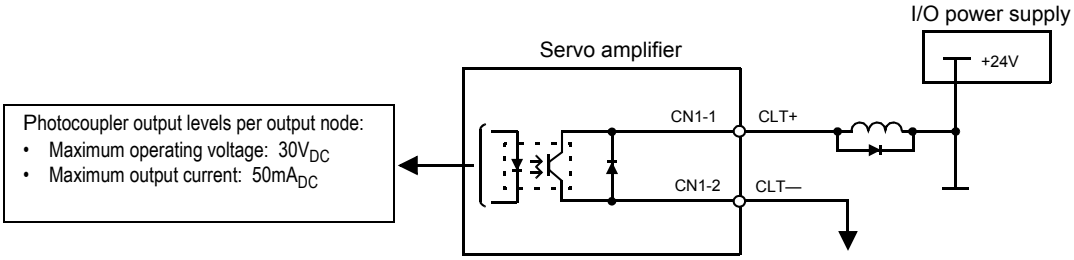
Note: If torque limit is set higher than the maximum torque of the servomotor, the maximum torque of the servomotor is the limit.

Application Example: Equipment Protection


Torque limit
Too small a torque limit will result in a insufficient torque during acceleration and deceleration.
Motor speed
Torque

Using the /CLT Signal

The following section describes the use of the contact output signal /CLT as a torque limit output signal.



Output /CLT CN1-1	Torque Limit Output	Speed/Torque Control, Position Control

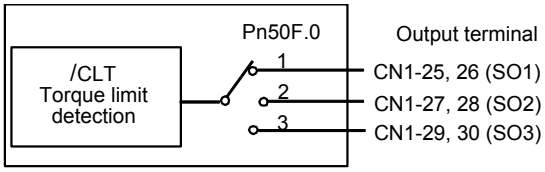
This signal indicates whether servomotor output torque (current) is being limited.

Status	Conditions	Description
ON	The circuit between CN1-1 and 2 is closed. CN1-1 is at low level.	Servomotor output torque is being limited. (Internal torque reference is greater than the limit setting).
OFF	The circuit between CN1-1 and 2 is open. CN1-1 is at high level.	Servomotor output torque is not being limited. (Internal torque reference is less than the limit setting).

Settings: Pn402 (Forward Torque Limit)
Pn403 (Reverse Torque Limit)
Pn404 (Forward External Torque Limit): /P-CL input only
Pn405 (Reverse External Torque Limit): /N-CL input only

When the /CLT signal is used, the following parameter must be used to select the output signal.

Parameter	Signal	Setting	Control Mode
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control



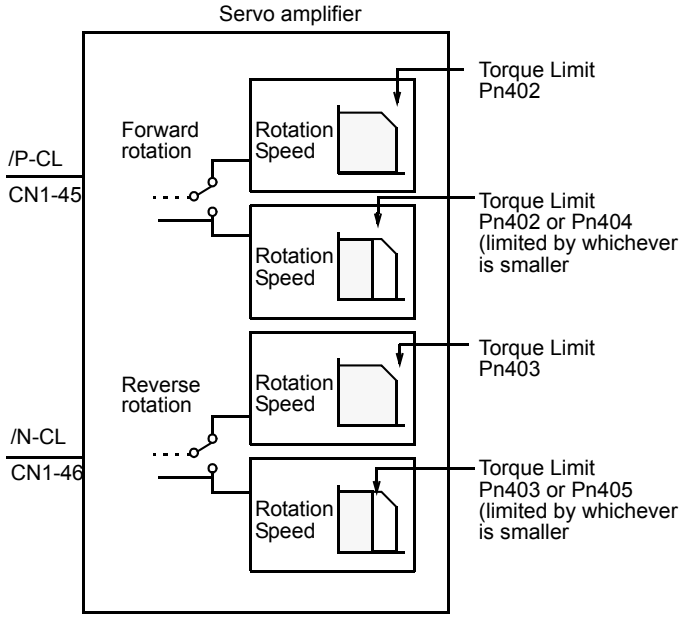
Use the following table to select which terminal will output the /CLT signal.

Parameter	Setting	Output Terminal (CN1-)	
		1	2
Pn50F.0	0	—	—
	1	25	26
	2	27	28
	3	29	30

Note: Multiple signals allocated to the same output circuit are output using OR logic. Set other output signals to a value other than that allocated to the /CLT signal in order to use just the /CLT output signal. *See 5.3.4 Output Circuit Signal Allocation.*

■ Setting Level 2: External Torque Limit

A contact input signal is used to enable the torque (current) limits previously set in parameters. Torque limits can be set separately for forward and reverse rotation.



Input /P-CL CN1-45	Forward External Torque Limit Input	Speed/Torque Control, Position Control
Output /N-CL CN1-46	Reverse External Torque Limit Input	Speed/Torque Control, Position Control

This is the external torque (current) limit input for forward and reverse rotation.

Check input signal allocation status when using this function. (See *5.3.3 Input Circuit Signal Allocation).* Default settings are given in the table on the following page.

Parameter	Signal Status	Comments	Description
/P-CL	CN1-45 at low level when ON	Use forward torque limit.	Limit: Pn404
	CN1-45 at high level when OFF	Do not use forward torque limit. Normal operation.	—
/N-CL	CN1-46 at low level when ON	Use reverse torque limit.	Limit: Pn405
	CN1-46 at high level when OFF	Do not use reverse torque limit. Normal operation.	—

The following output signals and monitor methods are used when torque is being limited.

Signal	Description
/CLT	Generated when Pn50F.0 is allocated to an output terminal from SO1 to SO3.
Monitor Mode (Un006)	—
• Un005: Numbers 6 and 7 (With Default Settings)	Refer to *7.1.7 Operation in Monitor Mode.*
• Un006: Depending on output signal allocation conditions.	—

Application Examples:

- Forced stop.
- Robot holding a workpiece.

Parameter	Signal	Setting (%)	Control Mode
Pn404	Forward External Torque Limit	Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control
Pn405	Reverse External Torque Limit	Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control

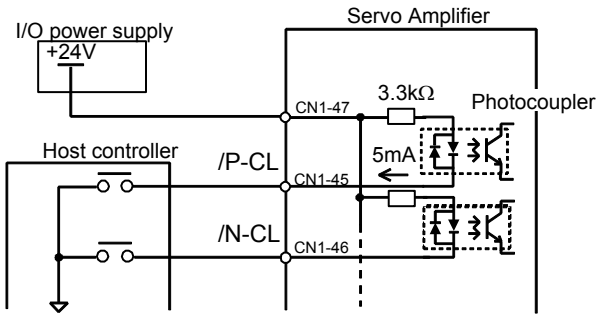
Set the torque limits when the torque is limited by an external contact input.

Setting	Description
/P-CL (CN1-45) Input	Pn404 torque limit applied.
/N-CL (CN1-46) Input	Pn405 torque limit applied.

See *5.2.10 Torque Limiting by Analog Voltage Reference.*

Using /P-CL and /N-CL Signals

The procedure for using /P-CL and /N-CL as torque limit input signals is illustrated below.

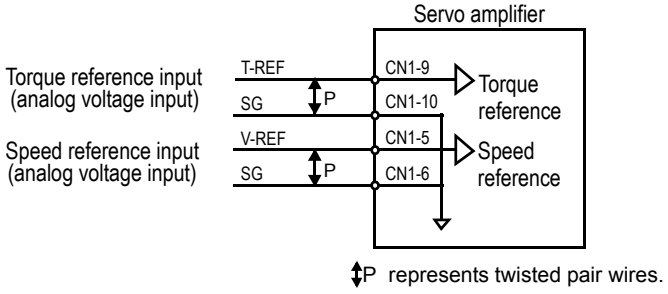


5.2 Settings According to Host Controller

This section describes the procedure for connecting a Sigma II Series servo to a host controller, including the procedure for setting related parameters.

5.2.1 Speed Reference

Input the speed reference using the input signal Speed Reference Input. Since this signal has various uses, set the optimum reference input for the system created.

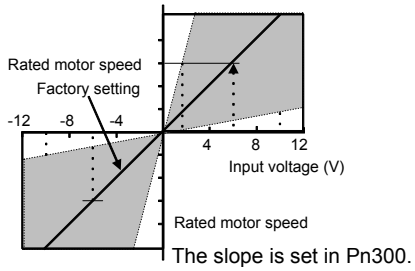


Input V-REF CN1-5	Speed Reference Input	Speed Control
Input SG CN1-6	Signal Ground	Speed Control

The above inputs are used for speed control (analog reference). (Pn000.1 = 0, 4, 7, 9, or A).

Always wire for normal speed control.

Refer to *7.1.7 Operation in Monitor Mode.* The motor speed is controlled in proportion to the input voltage between V-REF and SG.



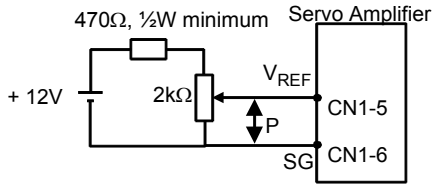
■ Setting Examples

Pn300 = 600: This setting means that 6V is equivalent to the rated motor speed.

Speed Reference Input	Rotation Direction	Motor Speed	SGMAH Servomotor
+6V	Forward rotation	Rated motor speed	3000rpm
+1V	Forward rotation	(1/6) rated motor speed	500rpm
-3V	Reverse rotation	(1/2) rated motor speed	1500rpm

Parameter Pn300 can be used to change the voltage input range.

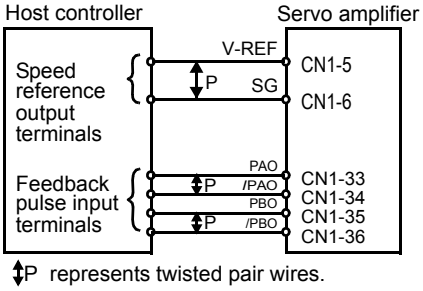
■ Input Circuit Example



- Always use twisted pair cable for noise control.

  Recommended variable resistor: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.

Connect V-REF and SG to the speed reference output terminals on the host controller when using a host controller, such as a programmable controller, for position control.

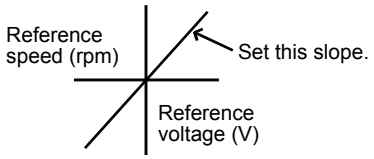


Adjust Pn300 according to the output voltage specifications of the host controller.

Adjust the speed reference input adjustment factor at the following parameter.

Parameter	Signal	Setting	Control Mode
Pn300	Speed Reference Input Adjustment Factor	Range: 150 to 3000 x (0.01V/ rated motor speed)	Speed Control

Set the voltage range for the speed reference input V-REF at CN1-5 according to host controller and external circuit output range.



The default setting is adjusted so that a 6V input is equivalent to the rated motor speed of all applicable servomotors.

Note: The maximum allowable voltage to the speed reference input (between CN1-5 and 6) is ± $12V_{DC}$.

Using the /P-CON Signal

Input P-CON CN1-41	Proportional Control Reference	Speed Control, Position Control

The /P-CON input signal switches the Speed Control Mode from PI (proportional-integral) to P (proportional) control.

Proportional control can be used in the following two ways:

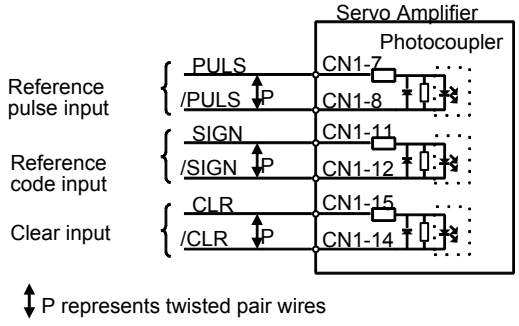
- When operation is performed by sending speed references from the host controller to the servo amplifier, the host controller can selectively use P control mode for particular conditions only. This method can prevent the occurrence of overshoot and also shorten settling time.
- If PI control mode is used when the speed reference has a reference offset, the motor may rotate at a very slow speed and fail to stop even if 0 is specified as a speed reference. In this case, use P control mode to stop the motor.

5.2.2 Position Reference

The reference pulse, reference code, and clear inputs are used for the position reference. Since this signal can be used in different ways, set the optimum reference input for the system created.

■ Reference by Pulse Input

Positioning is controlled by entering a reference pulse for a move.

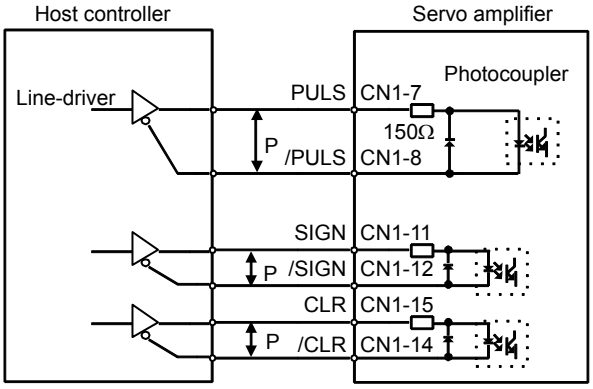


Any of the following forms can be used for the position reference:

- Line-driver output
- +12V open-collector output
- +5V open-collector output

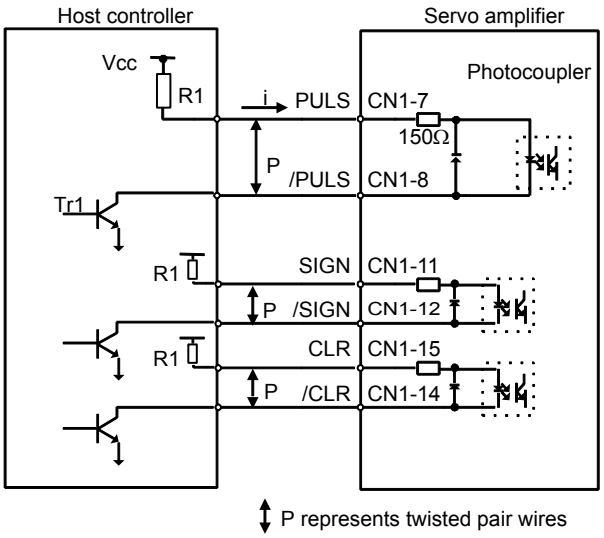
Connection Example 1: Line-driver Output

Applicable line driver: SN75174 manufactured by Texas Instruments Inc., MC3487 or equivalent



Connection Example 2: Open-collector Output

Set limiting resistor R1 so that input current, I, falls within the following range:



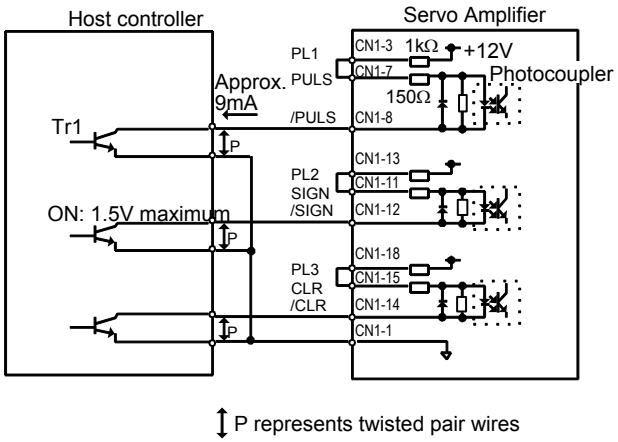
The examples below show how to select the pull-up resistor R1 so the input current, I, falls between 7 and 15mA.

Application Examples of V = IR	
R1 = 1kΩ with V_{CC} = 12V ±5%	R1 = 180Ω with V_{CC} = 5V ±5%

Note: The following table shows the signal logic for an open-collector output.

Tr1 Output Level	Signal Logic
ON	Equivalent to high-level input
OFF	Equivalent to low-level input

This circuit uses the 12V power supply built into the servo amplifier. The input is not isolated in this case.



Note: The noise margin of the input signal will decrease if the reference pulse is provided by an open-collector output. Set parameter Pn200.3 to 1 if the position drifts due to noise.

■ Selecting a Reference Pulse Form

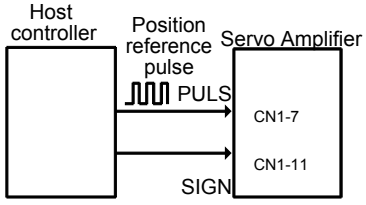
Use the following parameters to select the reference pulse form used.

Input PULS CN1-7	Reference Pulse Input	Position Control
Input /PULS CN1-8	Reference Pulse Input	Position Control
Input SIGN CN1-11	Reference Code Input	Position Control
Input /SIGN CN1-12	Reference Code Input	Position Control

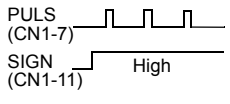
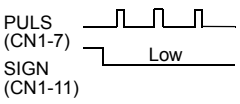
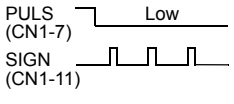
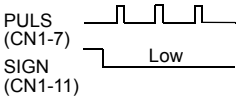
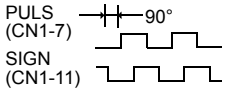
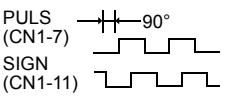
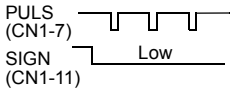
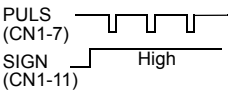
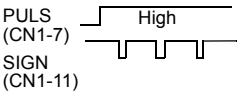
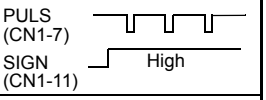
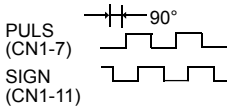
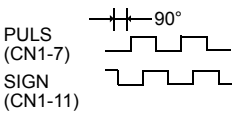
The servomotor only rotates at an angle proportional to the input pulse.

Parameter	Signal	Setting Range	Control Mode
Pn200.0	Reference Pulse Form	Default Setting: 0	Position Control

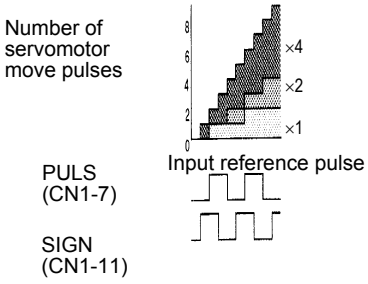
Set reference pulse form input to the servo amplifier from the host controller.



Since the reference pulse form can be selected from among those listed below, set one according to host controller specifications.

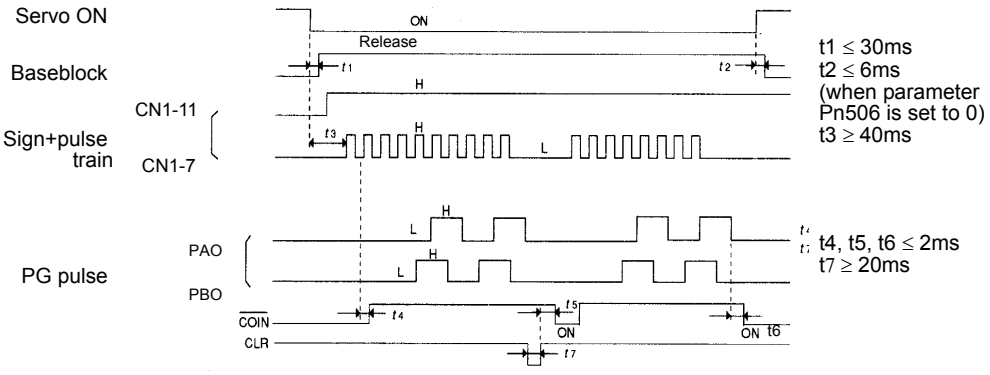
Parameter Pn200.0	Reference Pulse Form	Input Pulse Multiplier	Logic	Forward Rotation Reference	Reverse Rotation Reference
0	Sign + pulse train	—	Positive logic		
1	CW pulse + CCW pulse	—			
2	Two-phase pulse train with 90° phase differential	×1			
3		×2			
4		×4			
5	Sign + pulse train	—	Negative logic		
6	CW pulse + CCW pulse	—			
7	Two-phase pulse train with 90° phase differential	×1			
8		×2			
9		×4			

Input Pulse Multiplier



The input pulse multiplier function can be used if the reference pulse is a two-phase pulse train with a 90° phase differential. The electronic gear function can also be used to convert input pulses.

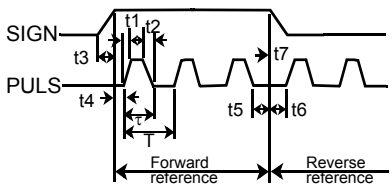
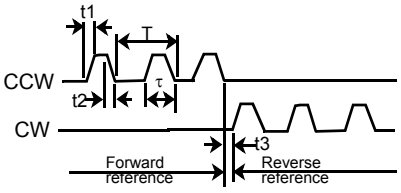
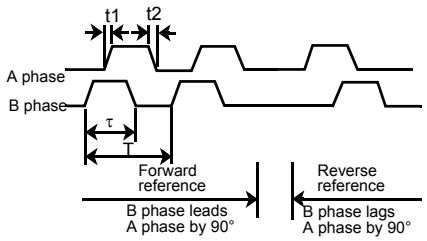
Example of I/O Signal Generation Timing



Note: 1. In order for the input pulse to register, the interval from the time the servo ON signal is turned ON until a reference pulse is entered must be a minimum of 40ms.

2. The error counter clear signal must be on for at least 20µs.

Reference Pulse Input Signal Timing

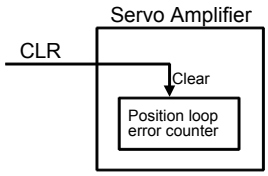
Reference Pulse Form	Electrical Specifications		
Sign + pulse train input (SIGN + PULS signal) Maximum reference frequency: 500kpps (200kpps open-collector output)		t1, t2 ≤ 0.1µs t3, t7 ≤ 0.1µs t4, t5, t6 > 3µs τ ≥ 1.0µs (τ/T) × 100 ≤ 50%	Sign (SIGN) H = Forward reference L = Reverse reference
CW pulse and CCW pulse Maximum reference frequency: 500kpps (200kpps open-collector output)		t1, t2 ≤ 0.1µs t3 > 3µs τ ≥ 1.0µs (τ/T) × 100 ≤ 50%	—
Two-phase pulse train with 90° phase differential (A phase + B phase) Maximum reference frequency × 1: 500kpps (200kpps open-collector output) ×2: 400kpps ×4: 200kpps		t1, t2 ≤ 0.1µs τ ≥ 1.0µs (τ/T) × 100 = 50%	Parameter Pn200.0 is used to switch the input pulse multiplier mode.

■ Error Counter Clear Input

The procedure for clearing the error counter is described below.

Input CLR CN1-15	Clear Input	Position Control
Input /CLR CN1-14	Clear Input	Position Control

The following occur when the CLR signal is set to high level.

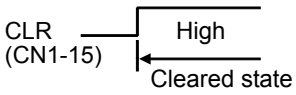
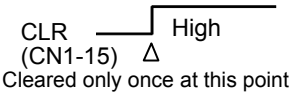
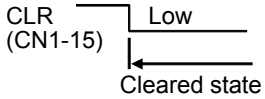
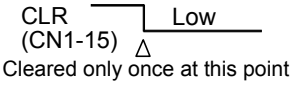


- The error counter inside the servo amplifier is set to 0.
- Position loop control is prohibited.

Use this signal to clear the error counter from the host controller or select the following clear operation through parameter Pn200.1.

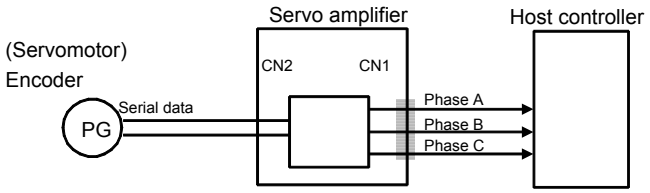
Parameter	Signal	Setting Range	Control Mode
Pn200.1	Error Counter Clear Signal Form	Default Setting: 0	Position Control

Select the pulse form for the error counter clear signal CLR (CN1-15).

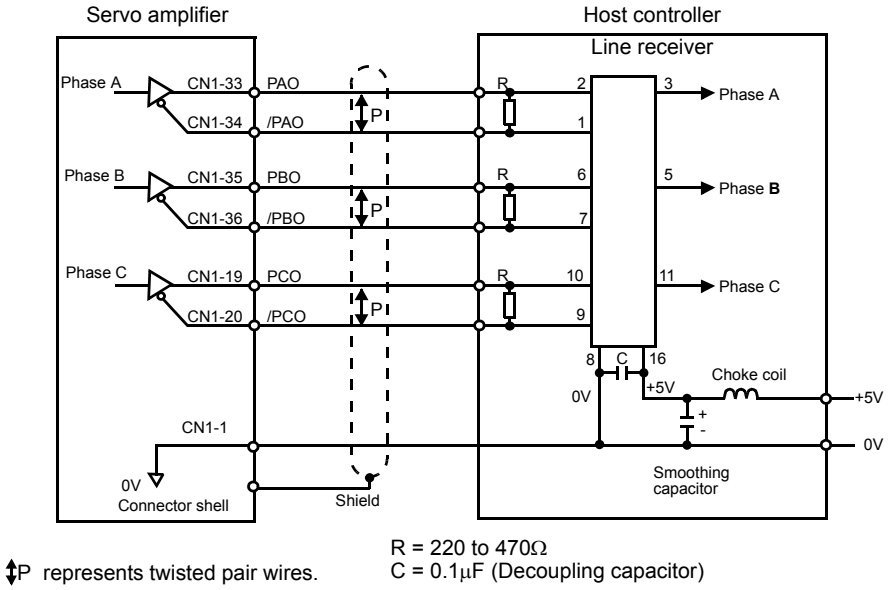
Pn200.1 Setting	Description	Clear Timing
0	Clears the error counter when the CLR signal goes high. Error pulses do not accumulate as long as the signal remains high.	
1	Clears the error counter on the rising edge of the CLR signal. Clears the error counter only once on the rising edge of the CLR signal.	
2	Clears the error counter when the CLR signal goes low. Error pulses do not accumulate as long as the signal remains low.	
3	Clears the error counter on the falling edge of the CLR signal. Clears the error counter only once on the falling edge of the CLR signal.	

5.2.3 Using the Encoder Signal Output

Encoder output signals divided inside the servo amplifier can be output externally. These signals can be used to form a position control loop in the host controller.



The output circuit is for line-driver output. Connect each signal line according to the following circuit diagram.



Note: Dividing means converting an input pulse train from the encoder mounted on the servomotor according to the preset pulse density and outputting the converted pulse. The units are pulses per revolution (PPR).

■ I/O Signals

I/O signals are described below.

Output PAO CN1-33	Encoder Output Phase A	Speed/Torque Control, Position Control
Output /PAO CN1-34	Encoder Output Phase /A	Speed/Torque Control, Position Control
Output PBO CN1-35	Encoder Output Phase B	Speed/Torque Control, Position Control
Output /PBO CN1-36	Encoder Output Phase /B	Speed/Torque Control, Position Control
Output PCO CN1-19	Encoder Output Phase C	Speed/Torque Control, Position Control
Output /PCO CN1-20	Encoder Output Phase /C	Speed/Torque Control, Position Control

Divided encoder signals are output.

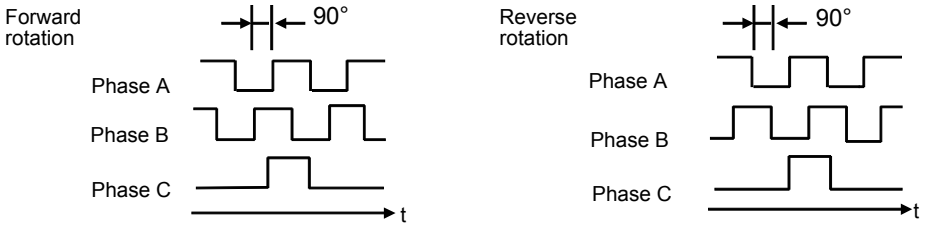
Always connect these signal terminals when a position loop is formed in the host controller for position control.

Set a dividing ratio at the following parameter.

PG Dividing Ratio	Pn201

The dividing ratio setting is not related to the gear ratio setting (Pn202 and 203) for the servo amplifier electronic gear function during position control.

Output Phase Form



Input SEN CN1-4	SEN Signal Input	Speed/Torque Control
Input /SEN CN1-2	Signal Ground	Speed/Torque Control
Output PSO CN1-48	Encoder Output Phase S	Speed/Torque Control, Position Control
Output /PSO CN1-49	Encoder Output Phase /S	Speed/Torque Control, Position Control
Input BAT (+) CN1-21	Battery (+)	Speed/Torque Control, Position Control
Input /BAT (-) CN1-22	Battery (-)	Speed/Torque Control, Position Control

Use SEN to BAT (-) signals for absolute encoders. See *5.7 Absolute Encoders* for more details.

Output SG CN1-1	Signal ground	Speed/Torque Control, Position Control

SG: Connect to 0V on the host controller.

IMPORTANT

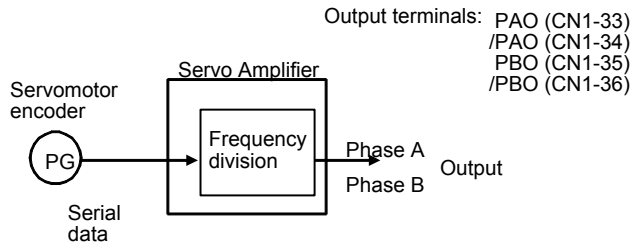
- **When using the servo amplifier phase C pulse signal to return to the machine origin, always turn the servomotor at least twice before starting the original return operation.**
  If the configuration of the mechanical system prevents turning the servomotor before the origin return operation, then perform the origin return operation at a servomotor speed of 600rpm or below. The phase C pulse signal may not be correctly applied if the servomotor turns faster than 600rpm.

■ Pulse Divider Setting

Set the pulse dividing ratio in the following parameter.

Parameter	Signal	Setting (PPR)	Control Mode
Pn201	PG Divider	Range: 16 to 16384 Default Setting: 16384	Speed/Torque Control, Position Control

Set the number of pulses for PG output signals (PAO, /PAO, PBO, /PBO).

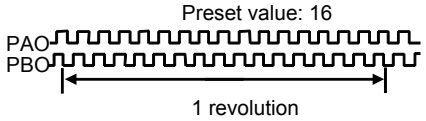


Pulses from the servomotor encoder (PG) are divided by the preset number before being output.

The number of output pulses per revolution is set at this parameter. Set the value using the reference units of the equipment or the controller used.

The setting range varies with the encoder used.

Setting Example



Servomotor Model and Encoder Specifications	Resolution (Bits)	Number of Encoder Pulses Per Revolution (PPR)	Setting Range
A	13	2048	16 to 2048
B, 1	16	16384	16 to 16384
C, 2	17		

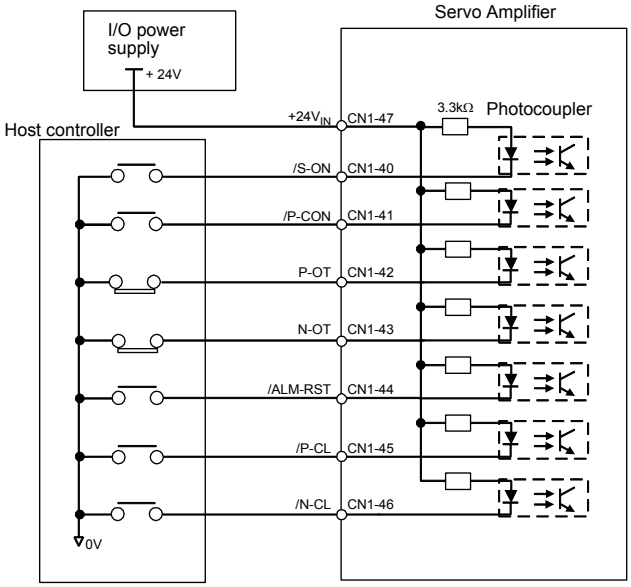
Note: 1. Turn OFF power once and turn ON again after changing the parameter.
2. A 13-bit encoder will run at 2048PPR even if the setting at Pn201 is set higher than 2049.

5.2.4 Sequence I/O Signals

Sequence I/O signals are used to control servo amplifier operation. Connect these signal terminals as required.

■ Input Signal Connections

Connect the sequence input signals as shown below.



Note: Provide a separate external I/O power supply; the servo amplifier does not have an internal 24V power supply.

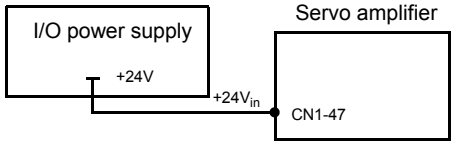
- External power supply specifications: 24V ±1 V_{DC}, 50mA minimum.

Yaskawa recommends using the same type of external power supply as that used for output circuits.

The function allocation for sequence input signal circuits can be changed.
See *5.3.3 Input Circuit Signal Allocation* for more details.

Input +24VIN CN1-47	External I/O Power Supply Input	Speed/Torque Control, Position Control

The external power supply input terminal is common to sequence input signals.

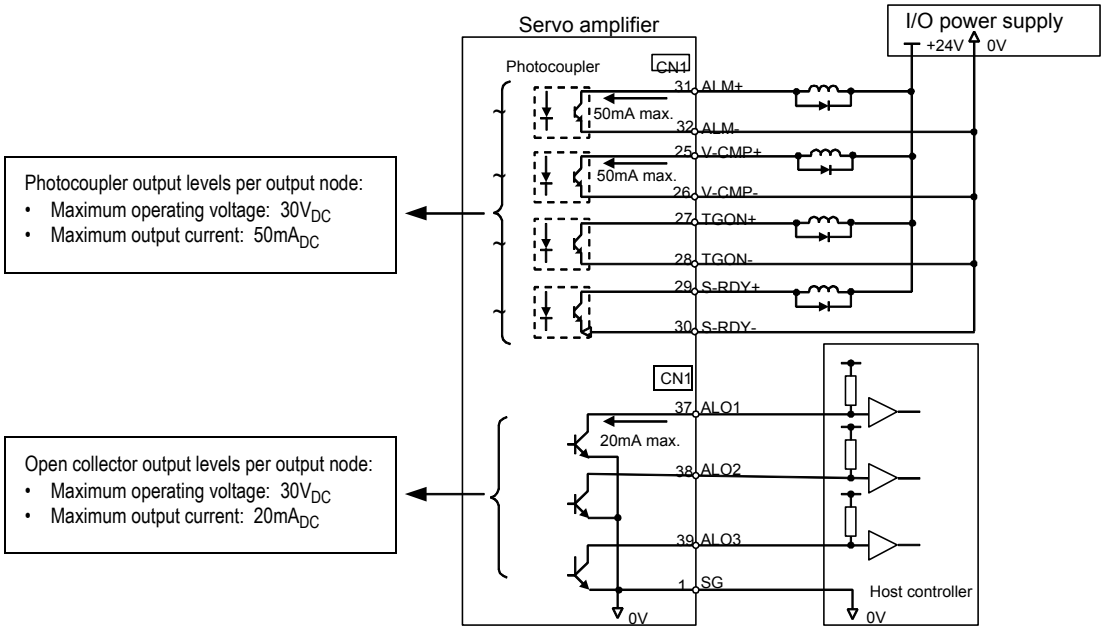


Connect an external I/O power supply

Contact input signals:
/S-ON (CN1-40)
/P-CON (CN1-41)
P-OT (CN1-42)
N-OT (CN1-43)
/ALM-RST (CN1-44)
/P-CL (CN1-45)
/N-CL (CN1-46)

■ Output Signal Connections

Connect the sequence output signals as shown in the following figure.



Note: Provide a separate external I/O power supply; the servo amplifier does not have an internal 24V power supply. Yaskawa recommends using the same type of external power supply as that used for input circuits.

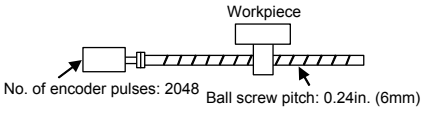
Function allocation for some sequence output signal circuits can be changed.

See *5.3.4 Output Circuit Signal Allocation* for more details.

5.2.5 Using the Electronic Gear Function

The electronic gear function enables the servomotor travel distance per input reference pulse to be set to any value. It allows the pulses generated by the host controller to be used for control without having to consider the equipment gear ratio or the number of encoder pulses.

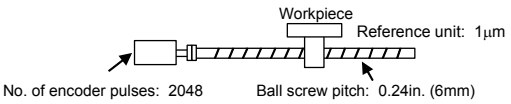
When the Electronic Gear Function is Not Used



To move a workpiece 0.39in. (10mm):

1 revolution = 6mm. Therefore,
10 ÷ 6 = 1.6667 revolutions.
(2048 × 4) pulses = 1 revolution. So,
(1.6667 × 2048 × 4) = 13653 pulses
13563 pulses are input as the reference.
The equation must be calculated at the host controller.

When the Electronic Gear Function is Used



To move a workpiece 0.39in. (10mm):

Equipment conditions and reference units must be defined for the electronic gear function beforehand.

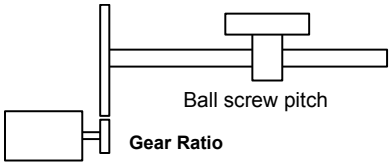
Reference unit is 1μm. Therefore,

$$\frac{10\text{mm}}{1\mu\text{m}} = 10000 \text{ pulses}$$

■ Setting the Electronic Gear

Calculate the electronic gear ratio (B/A) using the following procedure, and set the values in parameters Pn202 and 203.

1. Check equipment specifications related to the electronic gear:
   - Deceleration ratio
   - Ball screw pitch
   - Pulley diameter



2. Check the number of encoder pulses for the SGM□H servomotor.

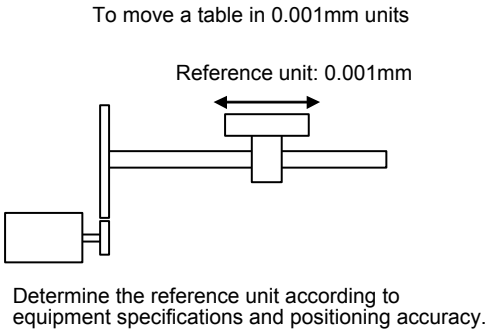
Servomotor Model and Encoder Specifications	Encoder Type	Number of Encoder Pulses Per Revolution (PPR)	
A	Incremental encoder	13-bit	2048
B		16-bit	16384
C		17-bit	32768
1	Absolute encoder	16-bit	16384
2		17-bit	32768

Note: The number of bits representing the resolution of the applicable encoder is not the same as the

number of encoder signal pulses (A and B phase) output from the servo amplifier.

3. Determine the reference unit used.

A reference unit is the minimum position data unit used to move a load. (Minimum unit of reference from the host controller).


To move a table in 0.001mm units
Reference unit: 0.001mm
Determine the reference unit according to
equipment specifications and positioning accuracy.

Examples (in mm):

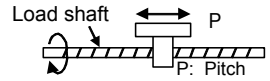
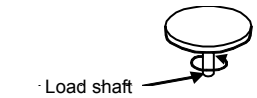
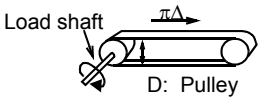
- Reference unit can be 0.1in or 0.01in or 0.01mm or 0.001mm, etc.
  A reference unit of one pulse moves the load by one reference unit.
- When the reference unit is 1μm
  If a reference of 50000 units is input, the load moves 50mm (1.97in) (50000 × 0.001mm = 50mm).

4. Determine the load travel distance per load shaft revolution in reference units.

$$\text{Travel distance per load shaft revolution} = \frac{\text{Travel distance per load shaft revolution}}{\text{Reference Unit}}$$

- When the ball screw pitch is 0.20in (5mm) and the reference unit is 0.00004in (0.001mm),

$$\frac{0.20}{0.00004} = 5000 \text{(reference units)}$$

Ball Screw	Disc Table	Belt and Pulley
 1 revolution = $\frac{P}{\text{reference unit}}$	 1 revolution = $\frac{360°}{\text{reference unit}}$	 1 revolution = $\frac{\pi D}{\text{reference unit}}$

5. Electronic gear ratio is given as: $\left(\frac{B}{A}\right)$

   If the gear ratio of the motor and the load shaft is given as: $\frac{m}{n}$

   where m is the rotation of the motor and n is the rotation of the load shaft,

   $$\text{Electronic gear ratio } \left(\frac{B}{A}\right) = \frac{\text{Number of encoder pulses} \times 4}{\text{Travel distance per load shaft revolution (reference unit)}} \times \frac{m}{n}$$

Note: Make sure the electronic gear ratio satisfies the following condition:

$0.01 \leq \text{Electronic gear ratio } \left(\frac{B}{A}\right) \leq 100$

The servo amplifier will not work properly if the electronic gear ratio exceeds this range. In that case, modify either the load configuration or the reference unit.

6. Set the parameters.

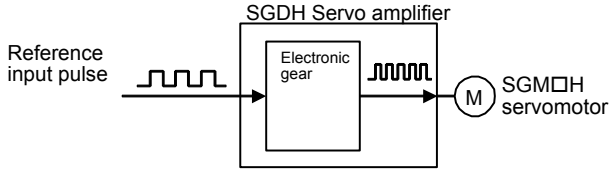
Reduce the electronic gear ratio to the lower terms so that both A and B are integers smaller than 65535, then set A and B in the respective parameters:

$\left(\frac{B}{A}\right)$

Pn202	Electronic Gear Ratio (Numerator)
Pn203	Electronic Gear Ratio (Denominator)

Parameter	Signal	Setting	Control Mode
Pn202	Electronic Gear Ratio (Numerator)	Range: 1 to 65535 Default Setting: 4	Position Control
Pn203	Electronic Gear Ratio (Denominator)	Range: 1 to 65535 Default Setting: 1	Position Control

Set the electronic gear ratio according to equipment specifications.



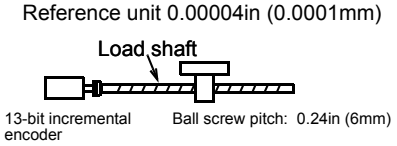
$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{\text{Pn202}}{\text{Pn203}}$$

- B = [(Number of encoder pulses) × 4] × [motor speed]
- A = [Reference units (travel distance per load shaft revolution)] × [load shaft revolution speed]

■ Electronic Gear Setting Examples

The following examples show electronic gear settings for different load mechanisms.

Ball Screws

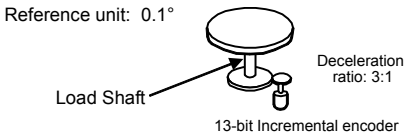


$$\text{Travel distance per load shaft revolution} = \frac{0.24\text{in}}{0.00004\text{in}} = 6000$$

$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2048 \times 4 \times 1}{6000} = \frac{\text{Pn202}}{\text{Pn203}}$$

Preset Values	Pn202	8192
	Pn203	6000

Circular Tables

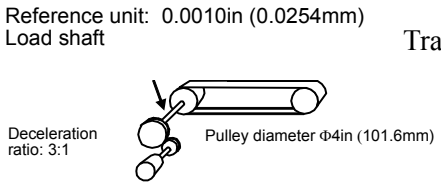


$$\text{Travel distance per load shaft revolution} = \frac{360°}{0.1°} = 3600$$

$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{2048 \times 4 \times 3}{3600} = \frac{\text{Pn202}}{\text{Pn203}}$$

Preset Values	Pn202	24576
	Pn203	3600

Belts and Pulleys



$$\text{Travel distance per load shaft revolution} = \frac{3.1416 \times 4\text{in}}{0.0010\text{in}} = 12566$$

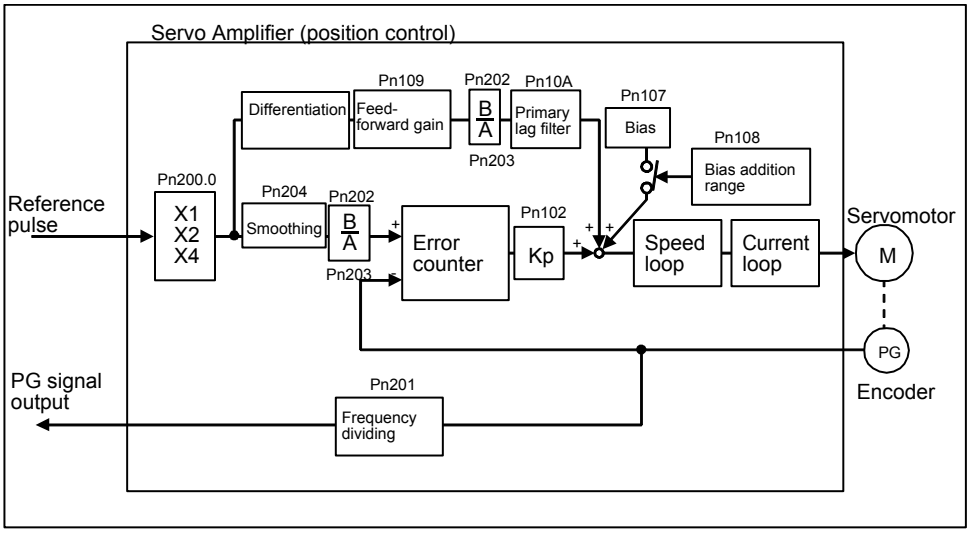
$$\text{Electronic gear ratio} = \left(\frac{B}{A}\right) = \frac{16384 \times 4 \times 3}{12566} = \frac{\text{Pn202}}{\text{Pn203}}$$

$$= \frac{196608}{12566} = \frac{20480}{1309}$$

Preset Values	Pn202	20480
	Pn203	1309

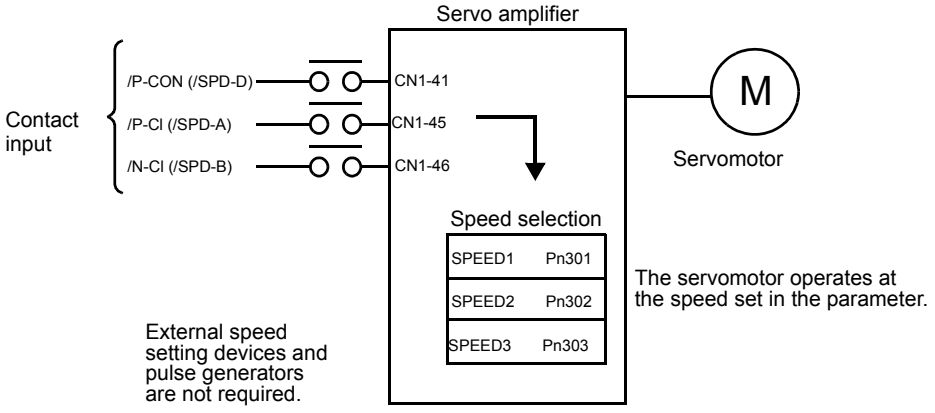
■ Control Block Diagram

The following diagram illustrates a control block for position control.



5.2.6 Contact Input Speed Control

This function provides a method for easy speed control. It allows the user to initially set three different motor speeds with parameters, and then select one of the speeds externally using a contact input.



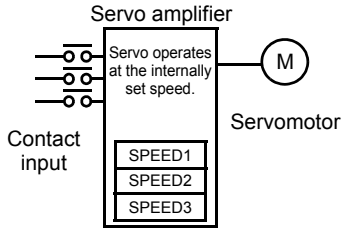
■ Using Contact Input Speed Control

Follow steps 1 to 3 below to use the contact input speed control function.

1. Set contact input speed control as shown below.

Parameter	Signal	Setting	Control Mode
Pn000.1	Control Mode Selection	Default Setting: 0	Speed/Torque Control, Position Control

The speed can be controlled via contact inputs.



Meanings for the following signals change when the contact input speed control function is used.

Pn000.1 Setting	Description	Input Signal			
0, 1, 2, 7, 8, 9, A, B	Contact input speed control function not used.	/P-CON (CN1-41)		Used to switch between P and PI control.	
		/P-CL (CN1-45)		Used to switch between forward external torque limit ON and OFF.	
		/N-CL (CN1-46)		Used to switch between reverse external torque limit ON and OFF.	
3, 4, 5, 6	Contact input speed control function used.	/P-CON (/SPD-D)	/P-CL (/SPD-A)	/N-CL (/SPD-B)	Speed setting
		Direction of rotation 0: Forward 1: Reverse	0	0	0 reference, etc.
			0	1	SPEED 1 (Pn301)
			1	1	SPEED 2 (Pn302)
			1	0	SPEED 3 (Pn303)

Note: 1. 0: OFF (high level); 1: ON (low level)

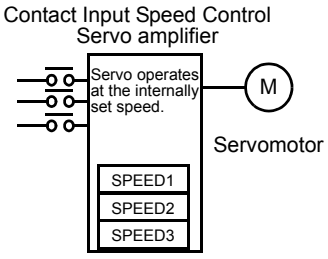
2. /P-CON, /P-CL and /N-CL functions differ from those in the table above when Pn000.1 is set to 3, 4, 5, or 6. The function is switched automatically when Pn50A. 0 is set to 0.

3. The /SPD-D, /SPD-A, and /SPD-B signals can be used only when signals are allocated to the input circuits. See *5.3.3 Input Circuit Signal Allocation.*

2. Set the motor speeds with the following parameters.

Parameter	Signal	Setting (rpm)	Control Mode
Pn301	Speed 1 (SPEED 1) (Contact Input Speed Control)	Range: 0 to 10000 Default Setting: 100	Speed Control
Pn302	Speed 2 (SPEED 2) (Contact Input Speed Control)	Range: 0 to 10000 Default Setting: 200	Speed Control
Pn303	Speed 3 (SPEED 3) (Contact Input Speed Control)	Range: 0 to 10000 Default Setting: 300	Speed Control

These parameters are used to set motor speeds when the contact input speed control function is selected. If the setting is higher than the maximum motor speed of the servomotor, then the servomotor will rotate at its maximum speed.

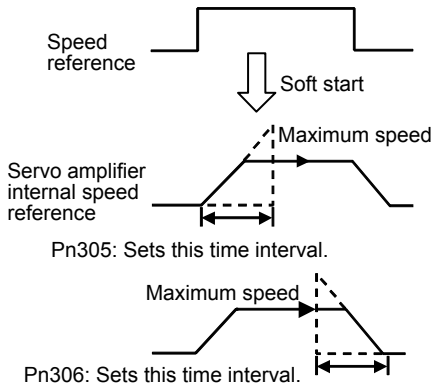


Speed selection input signals /P-CL(SPD-A)(CN1-45) and /N-CL (/SPD-B) (CN1-46) and the rotation direction selection signal /P-CON (/SPD-D)(CN1-41) enable the servomotor to run at the preset speeds.

3. Set the soft start time.

Parameter	Signal	Setting (ms)	Control Mode
Pn305	Soft Start Acceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control
Pn306	Soft Start Deceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control

The servo amplifier internal speed reference controls speed by applying this acceleration setting.



Smooth speed control can be performed by entering a progressive speed reference or using contact input speed control. Set each constant to 0 for normal speed control.

Set each parameter to the following time intervals.

- Pn305: Time interval from when the servomotor starts until it reaches maximum speed.
- Pn306: Time interval from when the servomotor reaches maximum speed until it stops.

■ Operation by Contact Input Speed Control

The following describes operation by contact input speed control.

Start and Stop

The following input signals are used to start and stop the servomotor.

Input /P-CL CN1-45	Speed Selection 1 (Forward External Torque Limit Input)	Speed/Torque Control, Position Control
Input /N-CL CN1-46	Speed Selection 2 (Reverse External Torque Limit Input)	Speed/Torque Control, Position Control

Use the following table when contact input speed control is used.

Contact Signal			Parameter	Selected Speed
/P-CON (/SPD-D)	/P-CL (/SPD-A)	/N-CL (/SPD-B)	Pn000.1	
-	0	0	3	Stopped by an internal speed reference of 0.
			4	Analog speed reference (V-REF) input
			5	Pulse reference input (position control)
			6	Analog torque reference input (torque control)
Direction of rotation 0: Forward 1: Reverse	0	1	3, 4, 5, 6, Common	SPEED 1 (Pn301)
	1	1		SPEED 2 (Pn302)
	1	0		SPEED 3 (Pn303)

Note: 1. 0: OFF (high level); 1: ON (low level)

2. Input signals indicated by the horizontal bar (-) are optional.

- When contact input speed control is not used, input signals are used as external torque limit inputs.

Note: The contact input speed control function is used only when signals are allocated to /SPD-D, /SPD-A, and /SPD-B.

Direction of Rotation Selection

The input signal /P-CON(/SPD-D) is used to specify the direction of servomotor rotation.

Input /P-CON CN1-41	Proportional Control Reference, etc.	Speed/Torque Control, Position Control

- When contact input speed control is used, the input signal /P-CON (/SPD-D) specifies the direction of servomotor rotation.

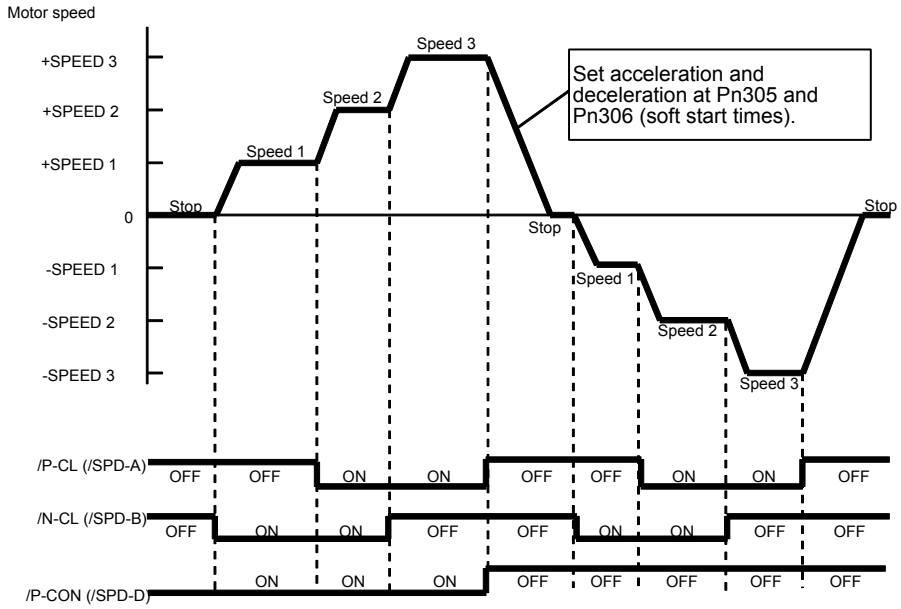
/P-CON (/SPD-D) Input Level	Signal Logic
0	Forward rotation
1	Reverse rotation

Note: 0: OFF (high level); 1: ON (low level)

- When contact input speed control is not used, the /P-CON signal is used for proportional control, zero clamping, and torque/speed control switching.

■ Example of Contact Input Speed Control Operation

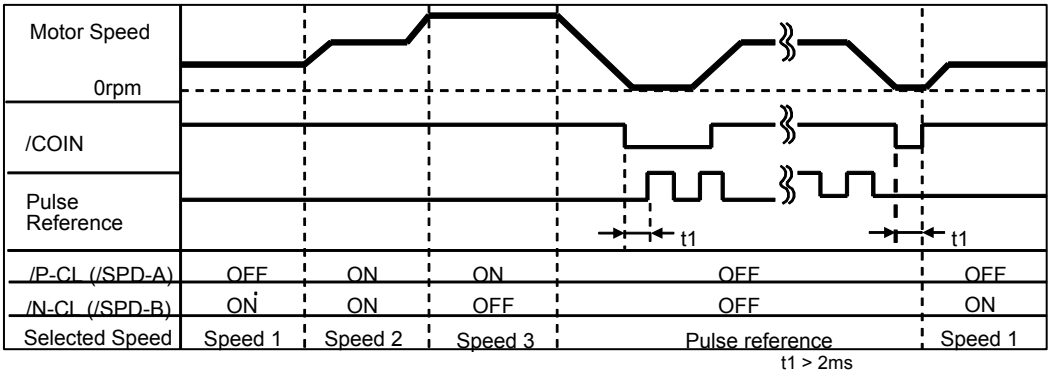
The following example shows operation by contact input speed control. Using the soft start function reduces physical shock when the speed is changed.



Note: When Pn000.1 set to 5, Soft Start is available only at contact input speed control, and unavailable in pulse reference input. If the Contact Input Speed Control Mode is switched to Pulse Reference Input Mode while the servomotor is operating at speed 1, speed 2, or speed 3, the servo amplifier will not receive a reference pulse until the positioning completed signal (/COIN) is output. Always start

pulse reference output from the host controller after a positioning completed signal is output from the servo amplifier.

Signal Generation Timing for Position Control



1. The above figure illustrates signal generation timing when the soft start function is used.
2. The value of t1 is not affected by the use of the soft start function. A maximum 2ms delay occurs when the /PC-L(/SPD-A) or /N-CL(/SPD-B) signal is read.

5.2.7 Using Torque Control

The SGDH servo amplifier limits torque as shown below.

- Level 1: Limits maximum output torque to protect the equipment or workpiece.
- Level 2: Limits torque after the Servomotor moves the equipment to a specified position (internal torque limit).
- Level 3: Controls torque output rather than speed output.
- Level 4: Switches between speed and torque control.

The following describes uses for levels 3 and 4 in the torque control function.

■ Torque Control Selection

Set the following parameter to select the type of control described in levels 3 and 4.

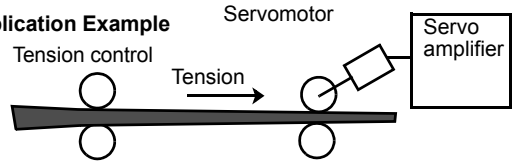
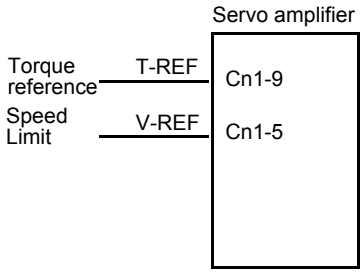
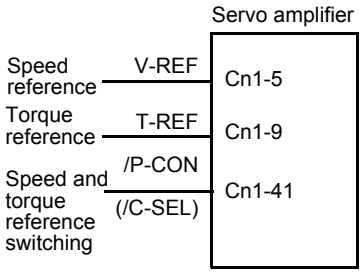
Parameter	Signal	Setting	Control Mode
Pn000.1	Control Method Selection	Default Setting: 0	Speed/Torque Control, Position Control

For further explanation of settings, See *Appendix B.2 Switches*.

A torque reference is entered from the host controller to the servo amplifier in order to control torque.

Application Examples

- Tension control
- Pressure control

<table>
<tr><td>Pn000.1</td><td colspan="2">Control Mode</td></tr>
<tr><td>2</td><td>Torque Control
This is a dedicated Torque Control Mode.
•A torque reference is input from T-REF (CN1-9).
•Speed reference input V-REF (CN1-5) cannot be used for speed control if Pn002.1 is set to 1.
•Parameter Pn407 can be used for maximum speed control.
Application Example
 
</td><td> 
</td></tr>
<tr><td>9</td><td>Torque Control <-> Speed Control (Analog Reference)
Switches between torque and speed control
•V-REF (CN1-5) inputs a speed reference or speed limit.
•T-REF (CN1-9) inputs a torque reference, torque feed-forward reference or torque limit depending on the control mode.
•/P-CON (/C-SEL)(CN1-41) is used to switch between torque and speed control.
<table><tr><th>CN1-41 State</th><th>Selects</th></tr><tr><td>Open</td><td>Torque Control</td></tr><tr><td>0V</td><td>Speed Control</td></tr></table>Torque Control: When /P-CON (/C-SEL) is OFF
•The T-REF reference controls torque.
•V-REF can be used to limit servomotor speed when Pn002.1 is set to 1. V-REF voltage (+) limit servomotor speed during forward and reverse rotation.
•Parameter Pn407 can be used to limit the maximum servomotor speed.</td><td> 
</td></tr>
</table>

<table>
<tr><th>Pn000.1</th><th>Control Method</th></tr>
<tr><td>9</td><td>Speed Control: When /P-CON (/C-SEL) is ON
Set the parameter Pn002.0 as shown below.

<table>
<tr><th>Parameter Pn002.0 State</th><th>Speed Reference Input (V-REF) (CN1-5,6)</th><th>Torque Reference Input (T-REF) (CN1-9,10)</th><th>Comments</th></tr>
<tr><td rowspan="2">0</td><td colspan="2">Speed Control</td><td rowspan="2"></td></tr>
<tr><td>Speed Reference</td><td>Cannot be used.</td></tr>
<tr><td rowspan="2">1</td><td colspan="2">Torque limit speed control by analog voltage reference</td><td rowspan="2">See 5.2.9 Speed Feed-Forward Function for more details on torque limit speed control by analog voltage reference.</td></tr>
<tr><td>Speed Reference</td><td>Torque Limit</td></tr>
<tr><td rowspan="2">2</td><td colspan="2">Speed control with torque feed-forward</td><td rowspan="2">See 5.2.8 Torque Feed-Forward Function for more details on torque feed-forward speed control.</td></tr>
<tr><td>Speed reference</td><td>Torque feed-forward</td></tr>
</table></td></tr>
<tr><td>8</td><td>Position Control ⇔ Torque Control
Can be used to switch between speed (contact reference) and torque control.
•/P-CON (/C-SEL)(CN1-41) is used to switch control.

<table>
<tr><th>CN1-41 State</th><th>Selects</th></tr>
<tr><td>Open</td><td>Position Control</td></tr>
<tr><td>0V</td><td>Torque Control</td></tr>
</table></td></tr>
<tr><td>6</td><td>Speed Control (Contact Reference) ⇔ Torque Control
Can be used to switch between speed (contact reference) and torque control.
•/P-CON (/C-SEL)(CN1-45) and /N-CL(SPD-B)(CN1-46) are used to switch control.

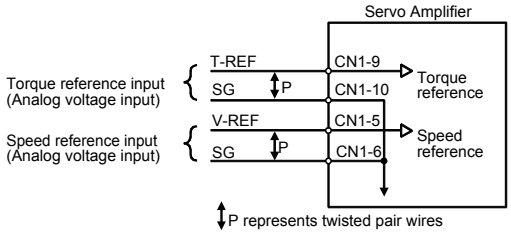
<table>
<tr><th>Parameter /P-CL (/SPD-A) CN1-45 State</th><th>Parameter /N-CL (/SPD-B) CN1-46 State</th><th></th></tr>
<tr><td>0</td><td>0</td><td>Torque Control</td></tr>
<tr><td>0</td><td>1</td><td rowspan="3">Speed Control (Contact reference)</td></tr>
<tr><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td></tr>
</table></td></tr>
</table>

Note: Input signal /C-SEL can be used only when a signal is allocated to the input circuit. *See 5.3.3 Input Circuit Signal Allocation.*

■ Input Signals

Torque Reference Inputs

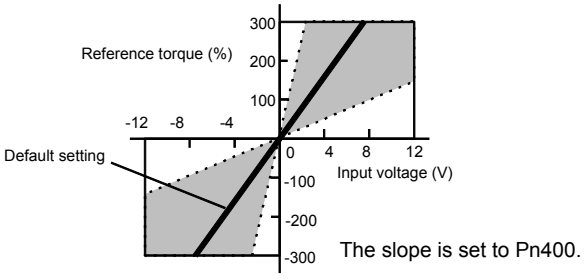
The following input signals are used for torque control.



Input T-REF CN1-9	Torque Reference Input	Speed/Torque Control
Input SG CN1-10	Signal Ground for the Torque Reference Input	Speed/Torque Control

These signals are used when torque control is selected.

Servomotor torque is controlled so that it is proportional to the input voltage between T-REF and SG.



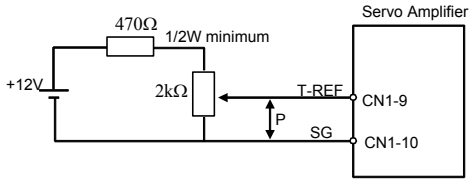
■ Default Settings

Parameter Pn400 establishes the voltage level that applies rated torque.

For example:

With Pn400 = 30	
VIN (V)	Resulting Applied Torque
+3	100% of rated torque in the forward direction
+9	300% of rated torque in the forward direction
-0.3	10% of rated torque in the reverse direction

■ Example of an Input Circuit



Note:

- Always use twisted pair cables for noise control.
- Recommended variable resistor: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.

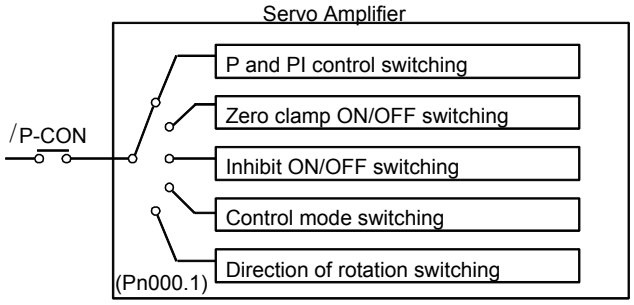
Speed Reference Inputs

Refer to *Section 5.2.1*.

Using the /P-CON Signal

Input /P-CON CN1-41	Proportional Control Reference, etc.	Speed/Torque Control, Position Control

The function of the input signal /P-CON varies with the setting applied to Pn000.1.



Pn000.1 Setting	/P-CON Function
0, 1	Switches between P (proportional) and PI (proportional-integral) control.
2	Not used.
3, 4, 5, 6	Switches the direction of rotation in Contact Input Speed Control Mode.
7, 8, 9	Switches the control mode.
A	Turns ON/OFF zero clamp.
B	Turns inhibit ON/OFF.

Note: The /P-CON signal function switches automatically when Pn50A.0 is set to 0.

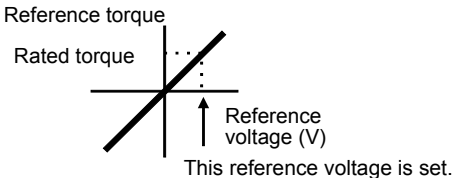
■ Torque Control Parameter

The following parameter is used for torque control. Set the parameter according to requirements of the servo system that is used.

Parameter	Signal	Setting (0.1V x rated torque)	Control Mode
Pn400	Torque Reference Input Gain	Setting Range: 10 to 100 Default Setting: 30	Speed/Torque Control

This parameter sets the voltage range for torque reference input T-REF (CN1-9) depending on the output range of the host controller or external circuit.

The default setting is 30, so the rated torque output is equal to 3V (30 × 0.1).



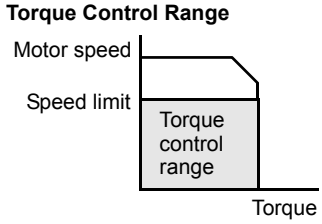
Pn002.1 Setting	Description
0	Uses speed limit set by Pn407 (internal speed limit function).
1	Uses V-REF (Cn1-5 and -6) as external speed limit input and sets speed limit by voltage, which are input to V-REF and Pn300 (external speed limit function).

Internal Speed Limit Function

Parameter	Signal	Setting (rpm)	Control Mode
Pn407	Speed Limit during Torque Control	Setting Range: 0 to 10000 Default Setting: 10000	Speed/Torque Control

This parameter sets a motor speed limit when torque control is selected. It is used to prevent excessive equipment speed during torque control.

Since the speed limit detection signal /VLT functions the same in torque control as the /CLT signal, see *5.1.3 Limiting Torque,* where the /CLT signal is described



The maximum speed of the servomotor will be used if Pn407 is set to a value higher than the maximum speed of the servomotor.

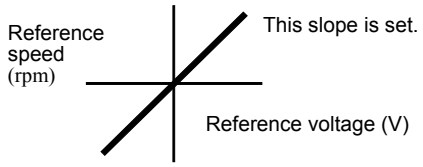
External Speed Limit function:

This function sets the voltage range for speed reference input V-REF (CN1-5) according to the output range of the host controller or external circuit.

When the default setting (600) is multiplied by 0.01V, the result (6V) corresponds to the rated motor speed.

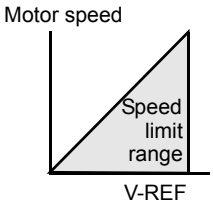
Parameter	Signal	Setting (0.01V /Rated Speed)	Control Mode
Pn300	Speed Reference Input Gain	Setting Range: 150 to 3000 Default Setting: 600	Speed/Torque Control

The default setting is 6V = the rated motor speed.



Principle of Speed Limit

When the control speed range is exceeded, torque, inversely proportional to the difference between the speed limit and the actual speed, is fed back in order to return the system to a level within the control speed range. In effect, the actual motor speed limit depends on the load condition.



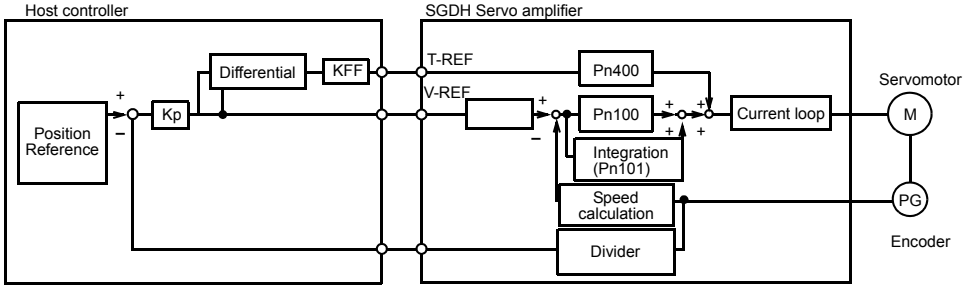
5.2.8 Torque Feed-Forward Function

The torque feed-forward function is used only in speed control (analog reference). This function is used to:

- Shorten positioning time.
- Differentiate a speed reference at the host controller to generate a torque feed-forward reference.
- Input this reference together with the speed reference to the servo amplifier.

Too high a torque feed-forward value will result in an overshoot or an undershoot. To prevent this, set the optimum value while closely observing the system response.

Connect a speed reference signal to V-REF (CN1-5 and 6) and a torque feed-forward reference signal to T-REF (CN1-9 and 10).



■ Using the Torque Feed-Forward Function

To use the torque feed-forward function, set the following parameter to 2.

Parameter	Signal	Setting	Control Mode
Pn002.0	Speed Control Option (T-REF Terminal Allocation)	Default Setting: 0	Speed/Torque Control

This setting enables the torque feed-forward function.

Pn002.0 Setting	T-REF Function
0	None.
1	T-REF terminal used for external torque limit input.
2	T-REF terminal used for torque feed-forward input.

The torque feed-forward function cannot be used with the torque limiting by analog voltage reference function described in *5.2.10 Torque Limiting by Analog Voltage Reference.*

■ Setting

Torque feed-forward is set using parameter Pn400.

The default setting at Pn400 is 30. If, for example, the torque feed-forward value is ±3V, then torque is limited to ±100% of the rated torque.

Parameter	Signal	Setting (0.1V/Rated Torque)	Control Mode
Pn400	Torque Reference Input Adjustment Factor	Setting Range: 0 to 100 Default Setting: 30	Speed/Torque Control

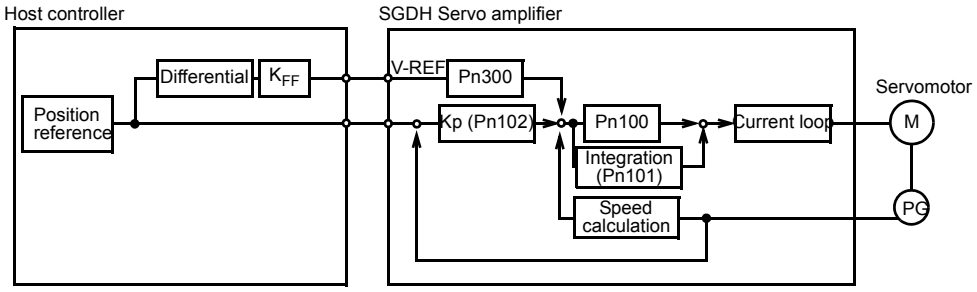
5.2.9 Speed Feed-Forward Function

The speed feed-forward function uses analog voltages and is effective only for position control. This function is used to:

- Shorten positioning time.
- Differentiate a position reference at the host controller to generate a speed feed-forward reference.
- Input this reference together with the position reference to the servo amplifier.

Too high a speed feed-forward value will result in either overshoot or undershoot. To prevent this, set the optimum value while closely observing the system response.

Connect a position reference signal to PULS and SIGN (CN1-7, 8, 11, and 12) and a speed feed-forward reference signal to V-REF (CN1-5 and 6).



Kp: Position loop gain
K_{FF}: Feed-Forward gain

■ Using the Speed Feed-Forward Function

To use the speed feed-forward function, set the following parameter to 1.

Parameter	Signal	Setting	Control Mode
Pn207.1	Speed Control Option	Default Setting: 0	Position Control

This setting enables the speed feed-forward function.

Pn207.1 Setting	T-REF Function
0	None.
1	V-REF terminal used for speed feed-forward input.

■ Setting

Speed feed-forward is set using parameter Pn300.

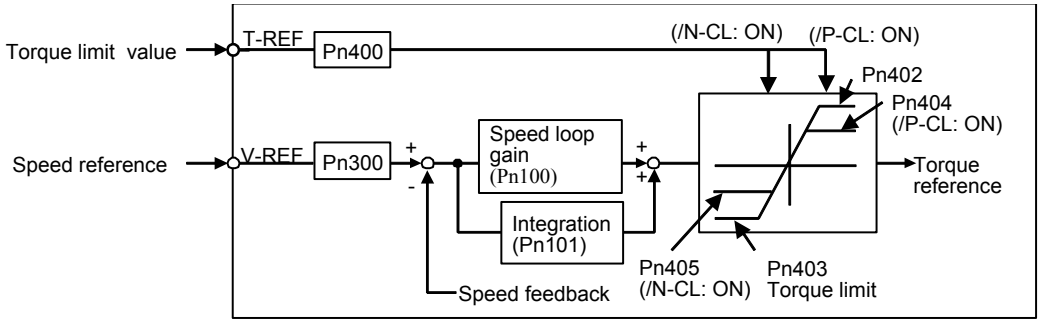
The default setting at Pn300 is 600. If, for example, the speed feed-forward value is ±6V, then speed is limited to ±100% of the rated torque.

Parameter	Signal	Setting (0.01V/Rated Speed)	Control Mode
Pn300	Speed Reference Input Adjustment Factor	Setting Range: 150 to 3000 Default Setting: 600	Position Control

5.2.10 Torque Limiting by Analog Voltage Reference

Torque limiting by analog voltage reference limits torque by assigning a torque analog voltage to the T-REF terminal (CN1-9 and 10). It cannot be used for torque control because the torque reference input terminal T-REF is used as an input terminal.

Torque is limited at the forward run side when the P-CL signal turns ON; and is limited at the reverse run side when the N-CL signal turns ON.



■ Using Torque Limiting by Analog Voltage Reference

To use this function, set the following parameter to 3:

Parameter	Signal	Setting (rpm)	Control Mode
Pn002.0	Speed Control Option (T-REF Terminal Allocation)	Default Setting: 0	Speed Control Position Control

This parameter can be used to enable torque limiting by analog voltage reference.

Pn002.0 Setting	T-REF Function
0	None.
1	T-REF terminal used for external torque limit input.
2	T-REF terminal used for torque feed-forward input.
3	T-REF terminal used for external torque limit input when P-CL and N-CL are valid.

This function cannot be used with the torque feed-forward function described in *5.2.8 Torque Feed-Forward Function.*

To use this function, verify how input signals have been allocated. (Refer to *Section 5.3.3 Input Circuit Signal Allocation*). The following table outlines factory default

settings.

Input Signal	Signal Level	Description	Comments
/P-CL	CN1-45 is at "L" level when ON	Torque is limited at the forward run side.	Limit value: either Pn404 or T-REF input, whichever is smaller.
	CN1-45 is at "H" level when OFF	Torque is not limited at the forward run side. Normal Operation	—
/N-CL	CN1-46 is at "L" level when ON	Torque is limited at the reverse run side.	Limit value: either Pn405 or T-REF input, whichever is smaller.
	CN1-46 is at "H" level when OFF	Torque is not limited at the forward run side. Normal operation.	—

■ Setting

The torque limit is set at parameter Pn400.

The default setting at Pn400 is 30. If, for example, the torque limit is ±3V, then torque is limited to 100% of the rated torque. (A torque value higher than 100% torque is clamped at 100%.)

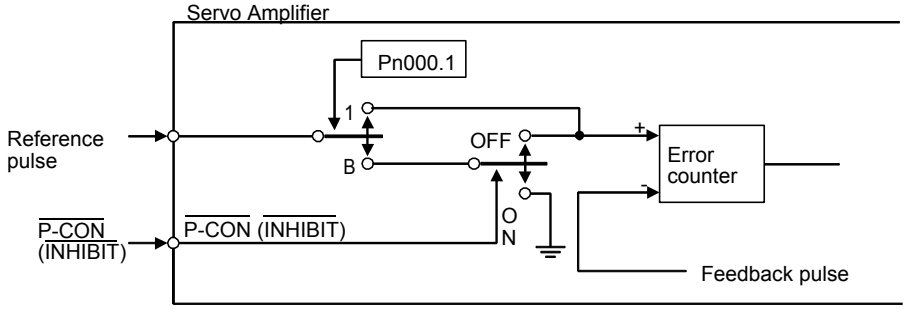
Parameter	Signal	Setting (rpm)	Control Mode
Pn400	Torque Reference Input Adjustment Factor	Setting Range: 0 to 100 Default Setting: 30	Speed/Torque Control

When either the P-CL or the N-CL signal is turned ON, the following torque limits become valid simultaneously.

Parameter	Signal	Setting (rpm)	Control Mode
Pn404	Forward Run Side External Torque Limit	Setting Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control
Pn405	Reverse Run Side External Torque Limit	Setting Range: 0 to 800 Default Setting: 100	Speed/Torque Control, Position Control

5.2.11 Reference Pulse Inhibit Function (/INHIBIT)

This function inhibits the servo amplifier from counting input reference pulses during position control. The servomotor remains locked (clamped) while the function is in use. The /P-CON(/INHIBIT) signal is used to enable or disable the function.



■Using Reference Pulse Inhibit Function (/INHIBIT)

To use the inhibit function, set the parameter as shown below.

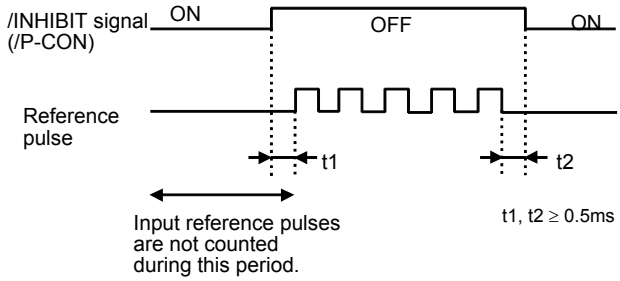
Parameter	Signal	Setting (rpm)	Control Mode
Pn000.1	Control Method Selection	Default Setting: 0	Position Control

The following settings enable the inhibit function.

<table>
<tr><th>Pn000.1 Setting</th><th colspan="2">Description</th></tr>
<tr><td>1</td><td colspan="2">Enables the inhibit function.
Always counts reference pulses.</td></tr>
<tr><td rowspan="3">B</td><td colspan="2">Enables the inhibit function. The /P-CON (/INHIBIT) signal is used to enable or disable the inhibit function.</td></tr>
<tr><td>/P-CON (/INHIBIT)</td><td>Description</td></tr>
<tr><td>OFF</td><td>Counts reference pulses.</td></tr>
<tr><td>ON</td><td>Prohibits the servo amplifier from counting reference pulses.
The servomotor remains locked.</td></tr>
</table>

Note: Parentheses ( ) around an /INHIBIT signal indicate that a signal has been allocated to the input circuit. *See 5.3.3 Input Circuit Signal Allocation* for more details.

Relationship between Inhibit Signal and Reference Pulses

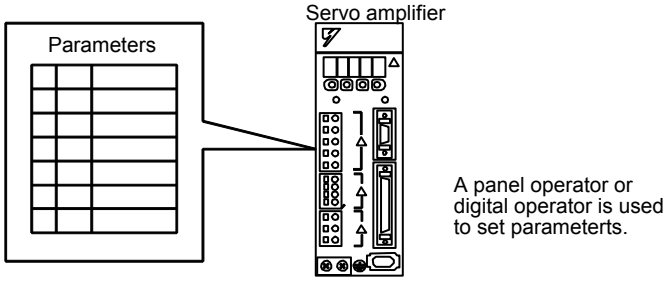


5.3 Setting Up the Servo Amplifier

This section describes the procedure for setting parameters to operate the SGDH servo amplifier.

5.3.1 Parameters

The Sigma II Series servo amplifier provides many functions and has parameters that allow the user to specify functions and perform fine adjustments.



Parameters are divided into the following three groups.

Parameter	Function
Pn000 to Pn601	Specify servo amplifier functions, set servo gains, etc.
Fn000 to Fn012	Execute auxiliary functions such as JOG Mode operations and origin searches.
Un000 to Un00D	Enable monitoring the motor speed and torque reference on the panel display.

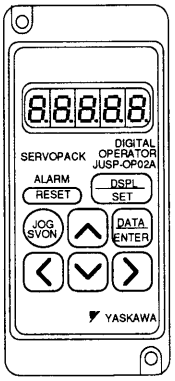
Note: Appendix B shows a list of parameters provided for reference. See *7.1.6 Operation in Parameter Setting Mode* for more details on the procedure for setting parameters.

5.3.2 JOG Speed

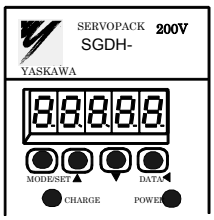
Use the following parameter to set or modify motor speed when operating the servomotor from a panel or digital operator.

Parameter	Signal	Setting (rpm)	Description
Pn304	JOG Speed	Setting Range: 0 to 10000 Default Setting: 500	Speed/Torque Control, Position Control

Use this parameter to set the motor speed when operating the servomotor from a panel or digital operator. If the setting is higher than the maximum motor speed of the servomotor, then the servomotor will rotate at its maximum speed.



Digital Operator



Panel Operator

5.3.3 Input Circuit Signal Allocation

The functions allocated to sequence input signal circuits can be changed. CN1 connector input signals are allocated with the default settings as shown in the following table.

CN1 Connector Terminal Numbers	Input Terminal Name	Default Setting	
		Symbol	Name
40	SI0	/S-ON	Servo ON
41	SI1	/P-CON	(Proportional control reference) *
42	SI2	P-OT	Forward run prohibit
43	SI3	N-OT	Reverse run prohibit
44	SI4	/ALM-RST	Alarm reset
45	SI5	/P-CL	(Forward current limit) *
46	SI6	/N-CL	(Reverse current limit) *

Note: * The functions of these input signals are automatically switched according to the setting at parameter Pn000.1 as long as Pn50A.0 is set to 0.

The following parameter is used to enable input signal allocation.

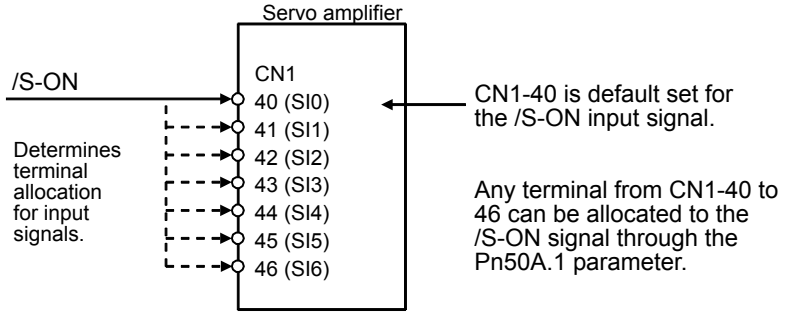
Parameter	Signal	Setting	Description
Pn50A.0	Input Signal Allocation Mode	Default Setting: 0	Speed/Torque Control, Position Control

Pn50A.0 Setting	Description
0	Default setting for sequence input signal allocation. This setting is the same as Yaskawa SGDB-□AD□ servo amplifiers.
1	Enables any sequence input signal settings.

Note: The default setting for parameter Pn50A.0 is 0. Functions and applications in this manual are generally described for the factory defaults.

■ Input Signal Allocation

The following signal can be allocated when Pn50A.0 is set to 1.



The following table shows the parameter default settings for input settings 1 to 4.

Parameter	Signal	Setting	Description
Pn50A	Input Signal Selection 1	Default Setting: 2100	Speed/Torque Control, Position Control
Pn50B	Input Signal Selection 2	Default Setting: 6543	Speed/Torque Control, Position Control
Pn50C	Input Signal Selection 3	Default Setting: 8888	Speed/Torque Control, Position Control
Pn50D	Input Signal Selection 4	Default Setting: 8888	Speed/Torque Control, Position Control

Select the input terminal on the CN1 connector that will be used for each input signal.

■ Examples of Input Signal Allocation

The procedure used to allocate sequence input signals is described using the /S-ON signal as a typical example.

Pn50A.1 Setting	Description	
0	Inputs the /S-ON signal from the SI0 (CN1-40) input terminal.	Signal polarity: Normal. Servo ON signal is valid when low (ON)
1	Inputs the /S-ON signal from the SI1 (CN1-41) input terminal.	
2	Inputs the /S-ON signal from the SI2 (CN1-42) input terminal.	
3	Inputs the /S-ON signal from the SI3 (CN1-43) input terminal.	
4	Inputs the /S-ON signal from the SI4 (CN1-44) input terminal.	
5	Inputs the /S-ON signal from the SI5 (CN1-45) input terminal.	
6	Inputs the /S-ON signal from the SI6 (CN1-46) input terminal.	
7	Sets /S-ON signal so that it is always valid.	
8	Sets /S-ON signal so that it is always invalid.	
9	Inputs the S-ON signal from the SI0 (CN1-40) input terminal.	Signal polarity: Inversion. Valid at OFF (H level) with Servo ON signal
A	Inputs the/S-ON signal from the SI1 (CN1-41) input terminal.	
B	Inputs the S-ON signal from the SI2 (CN1-42) input terminal.	
C	Inputs the S-ON signal from the SI3 (CN1-43) input terminal.	
D	Inputs the S-ON signal from the SI4 (CN1-44) input terminal.	
E	Inputs the S-ON signal from the SI5 (CN1-45) input terminal.	
F	Inputs the/S-ON signal from the SI6 (CN1-46) input terminal.	

As shown in the table above, the /S-ON signal can be allocated to any input terminal from SI0 to SI6. /S-ON is always input when Pn50A.1 is set to 7, and an external signal line would therefore not be needed because the servo amplifier will determine whether the servo is ON or OFF.

The /S-ON signal is not used when Pn50A.1 is set to 8. This setting is meaningful only in the following instances.

- When the factory set input signal are to be replaced by another input signal.
- The signal must be left ON (low level) during normal operation to make the signal valid when OFF (high level) when forward run prohibit (P-OT) and reverse run prohibit (N-OT) are input. The input terminal signal line must be left ON even in system configurations that do not require this signal, but unnecessary wiring can be eliminated by setting Pn50A.1 to 8.
- By setting 9 to F, the signal polarity can be reversed.

Note: Several signals can be allocated to the same input circuit.

When the servo is ON, the forward run prohibit or reverse run prohibit signal is used.

At a setting with inverted polarity, the failed safe operation may not be possible in the case of signal line disconnection.

■ Allocating Other Input Signals

Input signal allocation can be changed as shown below.

Input Signal		Parameter		Description
Name	Applicable Logic	Number	Setting	
Proportional Control Reference (/P-CON)	ON (low level)	Pn50A.2	0	Inputs the specified signal from SI0 (CN1-40).
			1	Inputs the specified signal from SI1 (CN1-41).
			2	Inputs the specified signal from SI2 (CN1-42).
			3	Inputs the specified signal from SI3 (CN1-43).
			4	Inputs the specified signal from SI4 (CN1-44).
			5	Inputs the specified signal from SI5 (CN1-45).
			6	Inputs the specified signal from SI6 (CN1-46).
			7	Sets the specified signal to always enabled.
			8	Sets the specified signal to always disabled.
			9	Inputs the specified inverse signal from SI0 (CN1-40).
			A	Inputs the specified inverse signal from SI1 (CN1-41).
			B	Inputs the specified inverse signal from SI2 (CN1-42).
			C	Inputs the specified inverse signal from SI3 (CN1-43).
			D	Inputs the specified inverse signal from SI4 (CN1-44).
			E	Inputs the specified inverse signal from SI5 (CN1-45).
			F	Inputs the specified inverse signal from SI6 (CN1-46).
Forward Run Prohibit (P-OT)	OFF (high level)	Pn50A.3	0 to F	Same as above.*
Reverse Run Prohibit (N-OT)		Pn50B.0		
Alarm Reset (/ARM-RST)	ON (low level)	Pn50B.1		
Forward Current Limit (/P-CL)		Pn50B.2		
Reverse Current Limit (/N-CL)		Pn50B.3		
Contact Input Speed Control Selection (/SPD-D)	—	Pn50C.0		
Contact Input Speed Control Selection (/SPD-A)		Pn50C.1		
Contact Input Speed Control Selection (/SPD-B)		Pn50C.2		
Control Mode Selection (/C-SEL)	ON (low level)	Pn50C.3		
Zero Clamp (/ZCLAMP)		Pn50D.0		
Reference Pulse Inhibit (/INHIBIT)		Pn50D.1		
Gain Switching (/G-SEL)		Pn50D.2		

Note: "Same as above" means that input signals and terminals SI0 to SI6 are enabled or disabled through parameter settings 0 to 8.

5.3.4 Output Circuit Signal Allocation

■ Output Signal Allocation

Output signal functions can be allocated to the sequence signal output circuits shown below.

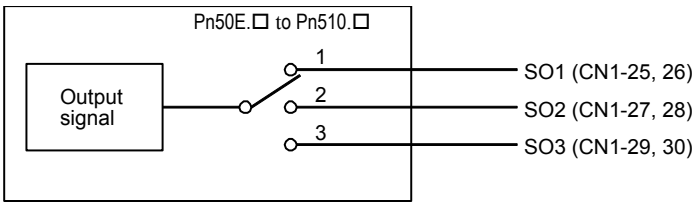
CN1 Connector Terminal Numbers	Output Terminal Name	Default Setting		Comments
		Symbol	Name	
25	SO1	/V-CMP+ (/COIN+)	Speed coincidence detection (positioning completed)	The signal output will vary depending on the control mode.
26 (SG)		/V-CMP– (/COIN–)		
27	SO2	/TGON+	Rotation detection	—
28 (SG)		/TGON–		
29	SO3	/S-RDY+	Servo ready	—
30 (SG)		/S-RDY–		

■ Output Signal Selection Default Settings

The output signal selection parameters and their default settings are shown below.

Parameter	Signal	Setting	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Speed/Torque Control, Position Control
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control
Pn510	Output Signal Selections 3	Default Setting: 0000	Speed/Torque Control, Position Control

Select the CN1 connector terminals that will output the signals.



■ Allocating Other Output Signals

Output Signal	Parameter		Description
	Number	Setting	
Positioning Completed (/COIN)	Pn50E.0	0	Disabled. (Not used for the specified output signal.)
		1	Outputs the specified signal from the SO1 (CN1-25 and 26) output terminal.
		2	Outputs the specified signal from the SO2 (CN1-27 and 28) output terminal.
		3	Outputs the specified signal from the SO3 (CN1-29 and 30) output terminal.
Speed Coincidence Detection (/V-CMP)	Pn50E.1	0 to 3	Same as above (Output signals are disabled or allocated to output terminals SO1 to SO3 through parameter settings 0 to 3).
Rotation Detection (/TGON)	Pn50E.2	0 to 3	
Servo Ready (/S-RDY)	Pn50E.3	0 to 3	
Torque Limit Detection (/CLT)	Pn50F.0	0 to 3	
Speed Limit Detection (/VLT)	Pn50F.1	0 to 3	
Brake Interlock (/BK)	Pn50F.2	0 to 3	
Warning (/WARN)	Pn50F.3	0 to 3	
Near (/NEAR)	Pn510.0	0 to 3	
Not used	—	—	—

Note: Signals are output with OR logic when multiple signals are allocated to the same output circuit. Signals that are not detected are invalid. For example, the positioning completed signal /COIN is invalid in Speed Control Mode.

The following parameters can be used to invert the signals on output terminals SO1 to SO3.

Parameter	Signal	Setting	Description
Pn512	Output Signal Inverted Setting	Default Setting: 0000	Speed/Torque Control, Position Control

These settings specify which of the connector CN1 output signals are to be inverted:

Output Terminal	Parameter		Description
	Number	Setting	
SO1 (CN1-25, 26)	Pn512.0	0	Does not invert the signal.
		1	Inverts the signal.

Output Terminal	Parameter		Description
	Number	Setting	
SO2 (CN1-27, 28)	Pn512.1	0	Does not invert the signal.
		1	Inverts the signal.
SO3(CN1-29, 30)	Pn512.2	0	Does not invert the signal.
		1	Inverts the signal.
Not used.	Pn512.3	—	—

5.3.5 Control Mode Selection

The SGDH servo amplifier offers speed control, position control, torque control, and the other control modes shown in the following table.

The following parameter is used to set the control mode.

Parameter	Signal	Setting	Description
Pn000.1	Control Mode Selection	Default Setting: 0	Speed/Torque Control, Position Control

Pn000.1 Setting	Control Mode
0	Speed Control (Analog Reference)
1	Position Control (Pulse Train Reference)
2	Torque Control (Analog Reference)
3	Contact Input Speed Control Selection (Contact Reference)
4	Contact Input Speed Control Selection (Contact Reference) ↔ Speed Control (Analog Reference)
5	Contact Input Speed Control Selection (Contact Reference) ↔ Position Control (Pulse Train Reference)
6	Contact Input Speed Control Selection (Contact Reference) ↔ Torque Control (Analog Reference)
7	Position Control (Pulse Train Reference) ↔ Speed Control (Analog Reference)
8	Position Control (Pulse Train Reference) ↔ Torque Control (Analog Reference)
9	Torque Control (Analog Reference) ↔ Speed Control (Analog Reference)
A	Speed Control (Analog Reference) ↔ Zero Clamp Control
B	Position Control (Pulse Train Reference) ↔ Position Control (Inhibit)

■ Description of Control Modes

The control modes are described below.

Speed Control (Analog Reference)

This mode controls speed using an analog voltage input reference. See *5.2.1 Speed Reference.*

Position Control (Pulse Train Reference)

This mode controls positioning using a pulse train input reference. See *5.2.2 Position Reference.*

Torque Control (Analog Reference)

This mode controls torque using an analog voltage input reference. See *5.2.7 Using Torque Control.*

Contact Input Speed Control Selection (Contact Reference)

This mode uses the /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) input signals to control speed as it switches among the three preset operating speeds in the servo amplifier. See *5.2.6 Contact Input Speed Control.*

Contact Input Speed Control Selection (Contact Reference) ↔ Speed Control (Analog Reference)

This mode controls speed by switching between contact reference and analog voltage reference speed control. Analog voltage reference speed control is enabled when both /P-CL (/SPD-A) and /N-CL (/SPD-B) input signals are OFF (high level). See *5.2.6 Contact Input Speed Control.*

Contact Input Speed Control Selection (Contact Reference) ↔ Position Control (Pulse Train Reference)

This mode switches between contact reference speed control and pulse train reference position control. Pulse train reference position control is enabled when both /P-CL (/SPD-A) and /N-CL (/SPD-B) input signals are OFF (high level). See *5.2.6 Contact Input Speed Control.*

Contact Input Speed Control Selection (Contact Reference) ↔ Torque Control (Analog Reference)

This mode switches between contact reference speed control and analog voltage reference torque control. Torque control using an analog voltage reference is enabled when both /P-CL (/SPD–A) and /N-CL (/SPD-B) input signals are OFF (high level). See *5.2.6 Contact Input Speed Control.*

Position Control (Pulse Train Reference) ↔ Speed Control (Analog Reference)

This mode switches between position and speed control through the /P-CON (/C-SEL) signal.

Position Control (Pulse Train Reference) ↔ Torque Control (Analog Reference)

This mode switches between position and torque control through the /P-CON (/C-SEL) signal.

Torque Control (Analog Reference) ↔ Speed Control (Analog Reference)

This mode switches between torque and speed control through the /P-CON (/C-SEL) signal. See *5.2.7 Using Torque Control.*

Speed Control (Analog Reference) ↔ Zero Clamp

This speed control mode is used to set the zero clamp function when the servo amplifier is stopped. Zero clamp operates when the /P-CON (/ZCLAMP) signal is ON (low level). See *5.4.3 Using the Zero Clamp Function.*

Position Control (Pulse Train Reference) ↔ Position Control (Inhibit)

This mode controls positioning by inhibiting reference pulse input through the /P-CON (/INHIBIT) signal. See *5.2.11 Reference Pulse Inhibit Function (/INHIBIT)*

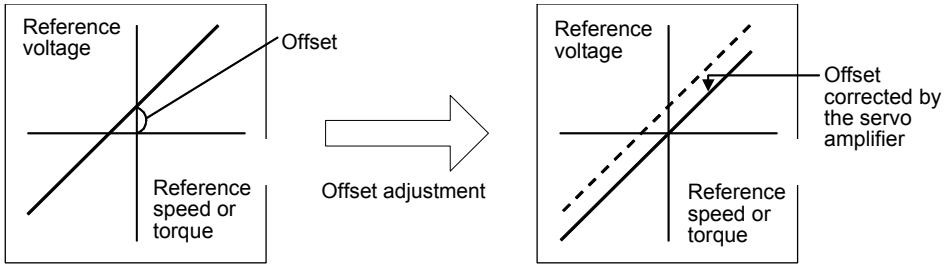
5.4 Setting Stop Functions

This section describes the procedure used to stop the servo amplifier properly.

5.4.1 Adjusting Offset

■ When the Servomotor Will Not Stop

The servomotor may rotate at very low speed and not stop even when 0V is specified as the reference voltage for servo amplifier speed and torque control (analog reference). This happens when the reference voltage from the host controller or external circuit is slightly offset (in mV units). The servomotor will stop if this offset is properly adjusted to 0V.



■ Reference Offset Adjustment

The following methods can be used to adjust the reference offset to 0V.

Adjustment Method	Result
Automatic Adjustment of Reference Offset	The reference offset is automatically adjusted to 0V.
Manual Adjustment of Reference Offset	The reference offset can be set to a specified value.

Note: Use manual rather than automatic adjustment if a position control loop is formed in the host controller.

See the following sections in *Chapter 7 Using the Digital Operator* for more details on adjustment procedures.

Adjustment Method	Reference Source
Automatic Adjustment of Reference Offset	*7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset*
Manual Adjustment of Reference Offset	*7.2.4 Manual Adjustment of the Speed and Torque Reference Offset*

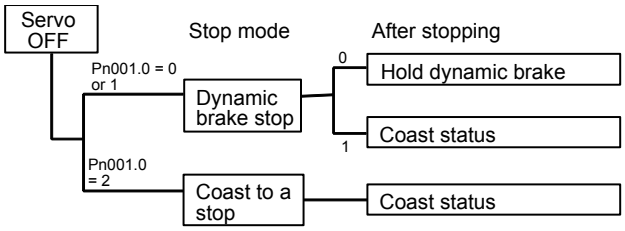
5.4.2 Servo OFF Stop Mode Selection

To stop the servomotor by applying the dynamic brake (DB), set the desired mode in the following parameter. The servomotor will stop due to equipment friction if the dynamic brake is not applied.

Parameter	Signal	Setting (ms)	Description
Pn001.0	Servo OFF or Alarm Stop Mode	Default Setting: 0	Speed/Torque Control, Position Control

The SGDH servo amplifier turns OFF under the following conditions:

- The Servo ON input signal (/S-ON, CN1-40) is turned OFF.
- A servo alarm occurs.
- Power is turned OFF.



Specify the Stop Mode if any of these occurs during operation.

Pn001.0 Setting	Result
0	Uses the dynamic brake to stop the servomotor. Maintains dynamic brake after the servomotor stops.*1
1	Uses the dynamic brake to stop the servomotor. Releases dynamic brake after the servomotor stops, and the servomotor coasts to a stop.
2	Coasts the servomotor to a stop.2) The servomotor is turned OFF and motion stops due to equipment friction.

Note: ***1.** If the servomotor is stopped or moving at extremely low speed, it will coast to a stop.

***2.** For the following servo amplifiers, the DB circuit is turned ON when the main power supply is OFF:

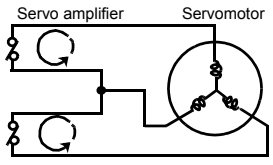
30 to 200W for 100V: SGDH-A3BE to -02BD
30 to 1500W for 200V: SGDH-A3AE to -15AE
0.5 to 7.5kW for 400V: SGDH-05DE to -75DE

For the above servo amplifiers, the DB Circuit is turned ON when the control power supply is OFF.

If the DB circuit needs to be turned OFF when the main power supply or the control power supply is OFF, disconnect the servomotor wiring (U, V, and W).

Note: The dynamic brake is an emergency stop function. Do not repeatedly start and stop the servomotor using the servo ON signal (/S-ON) or by repeatedly turning power ON and OFF.

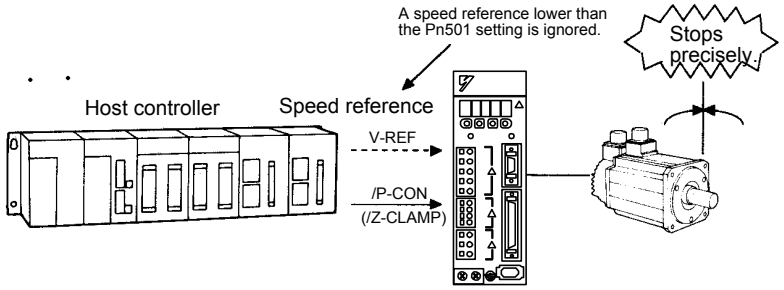
Note: **Dynamic brake (DB)** is a common way of quickly stopping a servomotor by electrically shorting its electrical windings. The DB circuit is incorporated into the servo amplifier.



5.4.3 Using the Zero Clamp Function

■ Zero Clamp Function

The zero clamp function is used for systems where the host controller does not form a position loop for the speed reference input. In other words, this function is used to stop and lock the servomotor even when the input voltage of speed reference V-REF is not 0V. An internal position loop is temporarily formed to clamp the servomotor within one pulse when the zero clamp function is turned ON. Even if the servomotor is forcibly rotated by external force, it will still return to the zero clamp position.



■ Parameter Setting

Set the following parameter so that the input signal /P-CON (/ZCLAMP) can be used to enable or disable the zero clamp function.

Parameter	Signal	Setting (ms)	Description
Pn000.1	Control Method Selection	Default Setting: 0	Speed Control

Input /P-CON CN1-41	Proportional Control, etc.	Speed/Torque Control, Position Control

Note: The /ZCLAMP signal can be used when an input circuit signal is allocated. See *5.3.3 Input Circuit Signal Allocation* for more details.

Pn000.1 Setting	Control Mode	
A	Zero Clamp Control Mode This mode allows the zero clamp function to be set when the servomotor stops. • The speed reference is input from V-REF (CN1–5). • /P-CON (/ZCLAMP)(CN1–41) is used to turn the zero clamp function ON and OFF. CN1-41 is open (OFF). — Turns the zero clamp function OFF. CN1-41 is 0V (ON). — Turns the zero clamp function ON.	Servo amplifier Speed reference — V-REF — CN1-5 Zero clamp — /P-CON — CN1-41 /ZCLAMP Zero clamp is performed when the following two conditions are satisfied: • /P-CON (/ZCLAMP) is ON. • Speed reference is below the setting designated at Pn501.

■ Setting Motor Speed

Use the following parameter to set the motor speed level at which zero clamp is performed

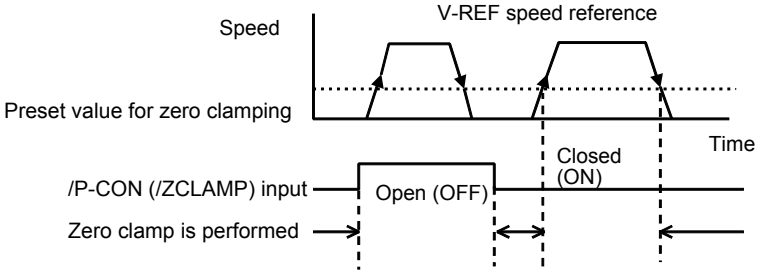
Parameter	Signal	Setting (rpm)	Description
Pn501	Zero Clamp Level	Setting Range: 0 to 10000 Default Setting: 10	Speed Control

If zero clamp speed control is selected, set the motor speed at which zero clamp is to be performed. The maximum speed will be used if the value of Pn501 is set higher than the maximum speed of the servomotor.

Zero Clamp Conditions

Zero clamp is performed when all the following conditions are satisfied:

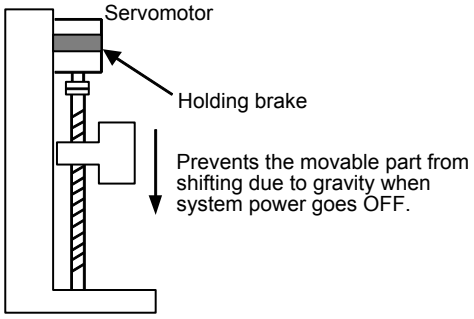
- Zero clamp speed control is selected (parameter Pn000.1 is set to A).
- /P-CON (/ZCLAMP)(CN1-41) is ON (0V).
- Speed reference drops below the setting level of Pn501.



Note: When the /ZCLAMP signal is allocated, the zero clamp operation will be used even for speed control (Pn000.1 = 0).

5.4.4 Using the Holding Brake

The holding brake is used when a servodrive controls a vertical axis. In other words, a servomotor with brake prevents the movable part from shifting due to the force of gravity when system power goes OFF.



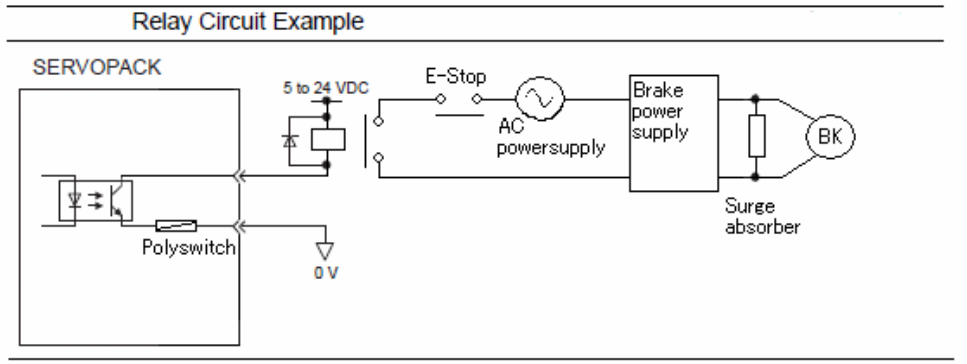
Note: The brake built into the servomotor SGM□H with brakes is a de-energization brake, which is used only to hold and cannot be used for braking. Use the holding brake only to hold a stopped motor. Brake torque is at least 120% of the rated motor torque.

Holding brakes are generally used for vertical load applications or when an external force must be applied to the shaft to prevent rotation due to gravity or another external force. Incorrect wiring or application of abnormal voltage to the servo amplifier output may cause damage to the amplifier and/or the machine. Therefore, care must be exercised when wiring the holding brake circuit. Please observe the following precautions and check the brake circuit wiring carefully.

Caution
• Faulty wiring or abnormal voltage may cause short-circuit failure in the output circuit of the servo amplifier • Short-circuit failure of the brake signal (/BK) could cause machine break-down and/or physical injury. • Check the wiring and perform trial runs with caution, especially with vertical load applications, and be sure to follow appropriate safety procedures

Addition of an outside interlock:

Safety can be enhanced by the addition of an interlock circuit.
Please examine the operation sequence of the emergency stop circuit in accordance with your system requirements. Asuggested interlock circuit is shown below:

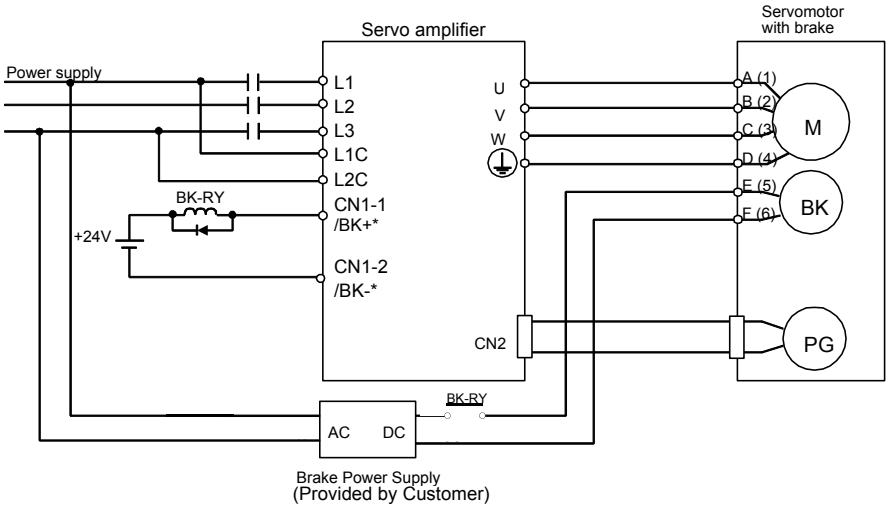


Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows:

- Voltage: 30 VDC
- Current: 50 mA DC

■ Wiring Example

Use the servo amplifier contact output signal /BK and the brake power supply to form a brake ON/OFF circuit. The following diagram shows a standard wiring example.



*CN1-1 /BK+ and CN1-2 /BK- are the output terminals allocated at parameter Pn50F.2.

Output /BK	Brake Interlock Output	Speed/Torque Control, Position Control

This output signal controls the brake when using a servomotor with a brake and does not have to be connected when using a servomotor without a brake.

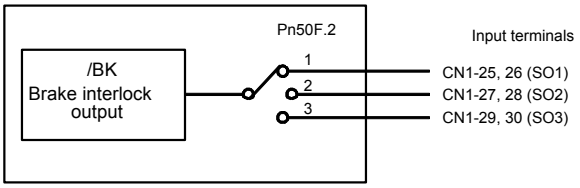
State	Status	Result
ON:	Closed or low level	Releases the brake.
OFF:	Open or high level	Applies the brake.

Related Parameters

Parameter	Description
Pn506	Time Delay from Brake Reference until Servo OFF
Pn507	Speed Level for Brake Reference Output during Motor Operation
Pn508	Timing for Brake Reference Output during Motor Operation

The following parameter must be selected to determine the location of the output signal, when the /BK signal is used.

Parameter	Signal	Setting	Description
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control



Select the /BK output terminal.

Parameter	Setting	Output Terminal (CN1)	
		1	2
Pn50F.2	0	—	—
	1	25	26
	2	27	28
	3	29	30

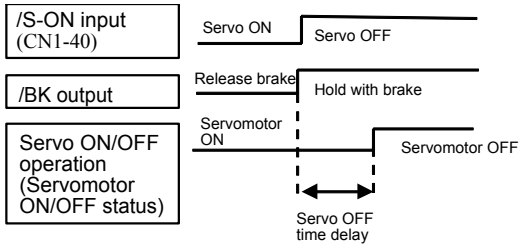
Note: Signals are output with OR logic when multiple signals are allocated to the same output circuit. Set other output signals to a value other than that allocated to the /BK signal in order to output the /BK signal alone. *See 5.3.4 Output Circuit Signal Allocation.*

■ Brake ON Timing

If the equipment moves slightly due to gravity when the brake is applied, set the following parameter to adjust brake ON timing.

Parameter	Signal	Setting (10ms)	Description
Pn506	Brake Reference Servo OFF Delay Time	Setting Range: 0 to 50 Default Setting: 0	Speed/Torque Control, Position Control

This parameter is used to set the output time from the brake control signal /BK until the servo OFF operation (servomotor output stop) when a servomotor with a brake is used.



With the standard setting, the servo is turned OFF when the /BK signal (brake operation) is active. The equipment may move slightly due to gravity depending on equipment configuration and brake characteristics. If this happens, use this parameter to delay servo OFF timing.

This setting sets the brake ON timing when the servomotor is stopped. Use Pn507 and 508 for brake ON timing during operation.

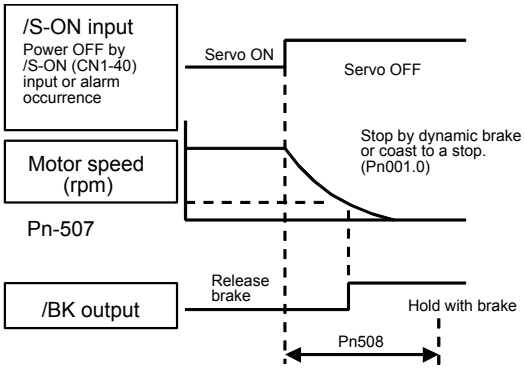
Note: The servomotor will turn OFF immediately if an alarm occurs. The equipment may move due to gravity in the time it takes for the brake to operate.

■ Holding Brake Setting

Set the following parameters to adjust brake ON timing so the holding brake is applied when the servomotor stops.

Parameter	Signal	Setting	Description
Pn507	Brake Reference Output Speed Level	Setting Range: 0 to 10000rpm Default Setting: 100rpm	Speed/Torque Control, Position Control
Pn508	Timing for Brake Reference Output during Motor Operation	Setting Range: 0 to 100 x 10ms Default Setting: 50 x 10ms	Speed/Torque Control, Position Control

Set the brake timing used when the servo is turned OFF by input signal /S-ON (CN1-40) or when an alarm occurs during motor operation.



Brake ON timing when the servomotor stops must be adjusted properly because servomotor brakes are designed as holding brakes. Adjust the parameter settings while observing equipment operation.

/BK Signal Output Conditions During Servomotor Operation

The circuit is open under either of the following conditions:

- Motor speed drops below the setting at Pn507 after servo OFF.
- The time set at Pn508 has elapsed since servo OFF.

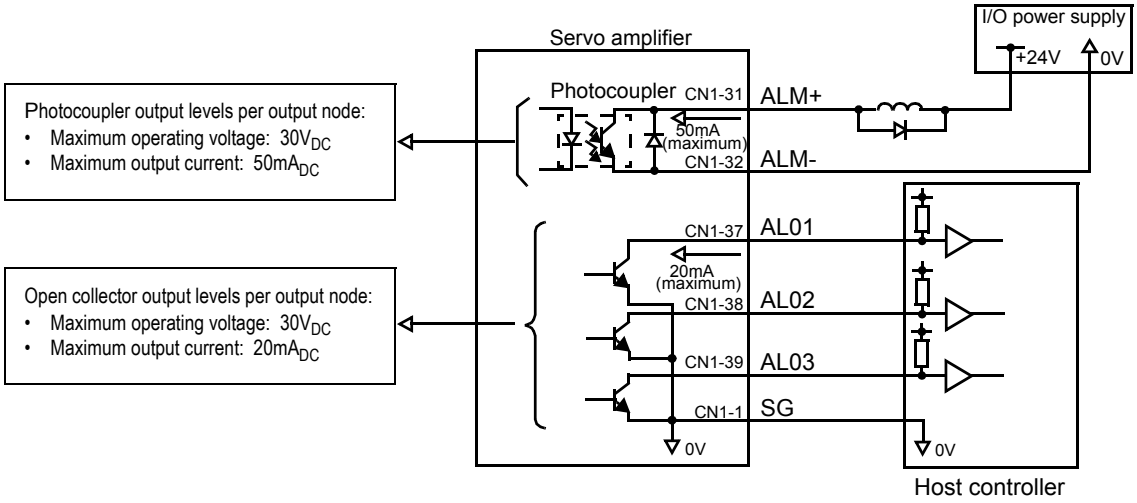
The actual speed used will be the maximum speed even if Pn507 is set higher than the maximum speed.

5.5 Forming a Protective Sequence

This section describes the procedure for using I/O signals from the servo amplifier to form a protective safety sequence.

5.5.1 Using Servo Alarm and Alarm Code Outputs

The basic procedure for connecting alarm output signals is described below.

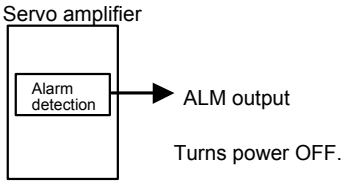


A suitable external I/O power supply must be provided by the user separately because there is no internal 24V power supply in the servo amplifier.

The use of the photocoupler output signals is described below.

Output	ALM+ CN1-31	Servo Alarm Output	Speed/Torque Control, Position Control
Output	ALM- CN1-32	Signal Ground for Servo Alarm Output	Speed/Torque Control, Position Control

These alarms are output when a servo amplifier alarm is detected.



Form an external circuit so this alarm output (ALM) turns OFF the servo amplifier.

State	Status	Result
ON	Circuit between CN1-31 and 32 is closed, and CN1-31 is at low level.	Normal state.
OFF	Circuit between CN1-31 and 32 is open, and CN1-31 is at high level.	Alarm state.

Alarm codes ALO1, ALO2 and ALO3 are output to indicate each alarm type.

The uses of open-collector output signals ALO1, ALO2, and ALO3 is described below.

Output ALO1 CN1-37	Alarm Code Output	Speed/Torque Control, Position Control
Output ALO2 CN1-38	Alarm Code Output	Speed/Torque Control, Position Control
Output ALO3 CN1-39	Alarm Code Output	Speed/Torque Control, Position Control
Output /SG CN1-1	Signal Ground for Alarm Code Output	Speed/Torque Control, Position Control

These signals output alarm codes to indicate the type of alarm detected by the servo amplifier. Use these signals to display alarm codes at the host controller. See *9.2.3 Alarm Display Table* for more on the relationship between alarm display and alarm code output.

When a servo alarm (ALM) occurs, eliminate the cause of the alarm and set the following /ALM-RST input signal to high level (ON) to reset the alarm.

Input /ALM-RST CN1-44	Alarm Reset	Speed/Torque Control, Position Control

The alarm reset signal is used to reset a servo alarm.

Form an external circuit so the servo amplifier turns OFF when an alarm occurs. Alarms are reset automatically when the control power supply is turned OFF.

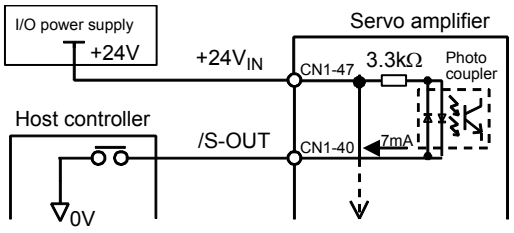
Alarms can also be reset using a panel or digital operator.

Note: **1.** Encoder alarms cannot always be reset by inputting the /ALM-RST signal. In that case, turn the control power supply OFF to reset the alarm.

2. When an alarm occurs, always eliminate the cause before resetting the alarm. See *9.2.1 Trouble-shooting Problems with Alarm Displays* for more details on troubleshooting the system when an alarm occurs.

5.5.2 Using the Servo ON Input Signal (/S-ON)

The basic use and wiring procedure for the Servo ON (/S-ON) input signal (sequence input signal) is described below. Use this signal to forcibly turn OFF the servomotor from the host controller.



Input /S-ON CN1-40	Servo ON	Speed/Torque Control, Position Control

This signal is used to turn the servomotor ON and OFF.

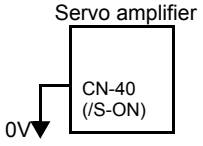
CN1-40 State	Status	Result
ON	Closed or low level	Turns ON the servomotor: operates according to signal input. This is the default state.
OFF	Open or high level	Servomotor cannot operate. Do not turn OFF the servomotor while it is operating except in an emergency.

⚠ CAUTION

- **Do not use the Servo ON (/S-ON) signal to start or stop the motor. Always use an input reference signal, such as Speed Reference to start or stop the servomotor.**
  Doing so will shorten the life of the servo amplifier.

Set the following parameter to 7 if the /S-ON signal will not be used.

Parameter	Signal	Setting	Description
Pn50A.1	/S-ON Signal Mapping	Default Setting: 0	Speed/Torque Control, Position Control



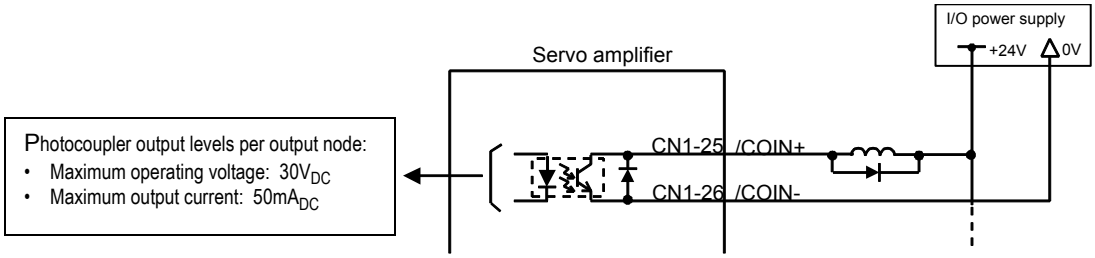
The external short-circuit wiring shown in the figure can be omitted if the Servo ON (/S-ON) input is not used.

Pn50A.1 Setting	Status	Result
0	Enables the servo ON (/S-ON) input signal.	The servo is OFF when CN-40 is open, and is ON when CN1-40 is at 0V.
7	Disables the servo ON (/S-ON) input signal.	The servo is always ON, and has the same effect as shorting CN1-40 to 0V.

Note See *5.3.3 Input Circuit Signal Allocation* for other Pn50A.1 settings.

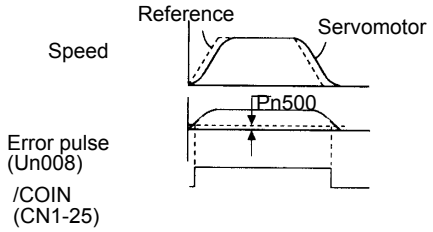
5.5.3 Using the Positioning Completed Output Signal (/COIN)

The basic use and wiring procedure for the positioning completed (/COIN) output signal (photocoupler output signal) is described below. The signal is output to indicate that servomotor operation is completed.



Output /COIN CN1-25	Positioning Completed Output Signal	Position Control

This signal indicates that servomotor movement has been completed during position control. The host controller uses the signal as an interlock to confirm that positioning is completed.



/COIN State	Status	Result
ON	Circuit between CN1-25 and 26 is closed, and CN1-25 is at low level.	Positioning is completed. (Position error is below the setting.)
OFF	Circuit between CN1-25 and 26 is open, and CN1-25 is at high level.	Positioning is not completed. (Position error is above the setting.)

The following parameter is used to change the CN1 connector terminal that outputs the /COIN signal.

Parameter	Signal	Setting (rpm)	Description
Pn50E	Output Signal Selection 1	Default Setting: 3211	Position Control

The parameter is factory set so the /COIN signal is output between CN1-25 and 26. See *5.3.4 Output Circuit Signal Allocation* for more details on parameter Pn50E.

The following parameter is used to set the number of error pulses and to adjust the output timing of the positioning completed signal.

Parameter	Signal	Setting (reference units*)	Description
Pn500	Positioning Completed Width	Setting Range: 0 to 250 Default Setting: 7	Position Control

Note: *reference units for this parameter are the number of input pulses as defined using the electronic gear function.

This parameter is used to set output timing for the positioning completed signal (/COIN) when the position reference pulse is input and servomotor operation is completed.

Set the number of error pulses in reference units.

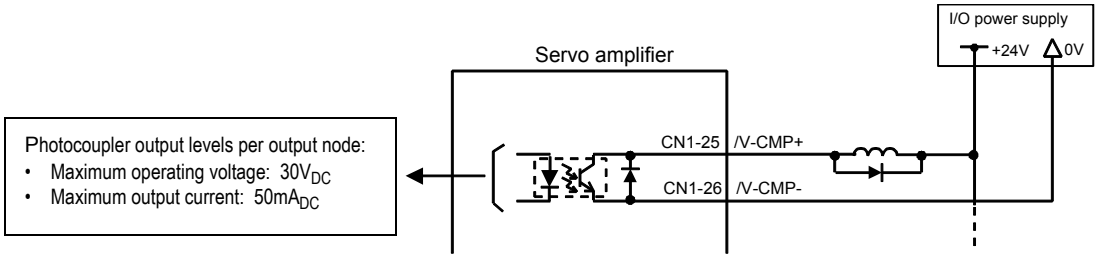
Too large a value set at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.

The positioning completed width setting has no effect on final positioning accuracy.

Note: /COIN is a position control signal.
With the default setting, this signal is used for the speed coincidence output /V-CMP for speed control, and it is always ON for torque control.

5.5.4 Speed Coincidence Output (/V-CMP)

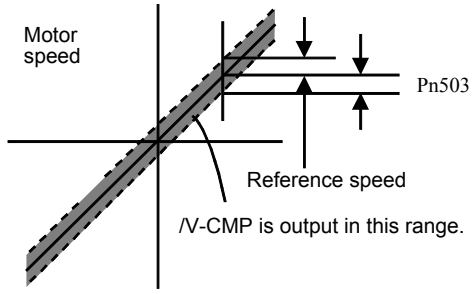
The basic use and wiring procedures for the speed coincidence (/V-CMP) output signal (photocoupler output signal), used to indicate a match with the speed reference, are described below. The host controller uses the signal as an interlock.



Output /V-CMP CN1-25	Speed Coincidence Output Signal	Speed Control

This signal is output when the actual motor speed during speed control is the same as the speed reference input.

/V-CMP State	Status	Result
ON	Circuit between CN1-25 and 26 is closed, and CN1-25 is at low level.	Speed coincides. (Speed error is below the setting).
OFF	Circuit between CN1-25 and 26 is open, and CN1-25 is at high level.	Speed does not coincide. (Speed error is above the setting).



The following parameter setting is used to change the CN1 connector terminal that outputs the /V-CMP signal.

Parameter	Signal	Setting (rpm)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

The parameter is default set so the /V-CMP signal is output between CN1-25 and 26. See *5.3.4 Output Circuit Signal Allocation* for more details on parameter Pn50E.

The following parameter is used to set conditions for speed coincidence output.

Parameter	Signal	Setting (rpm)	Description
Pn503	Speed Coincidence Signal Output Width	Setting Range: 0 to 100 Default Setting: 10	Speed Control

This parameter is used to set conditions for speed coincidence signal /TGON output.

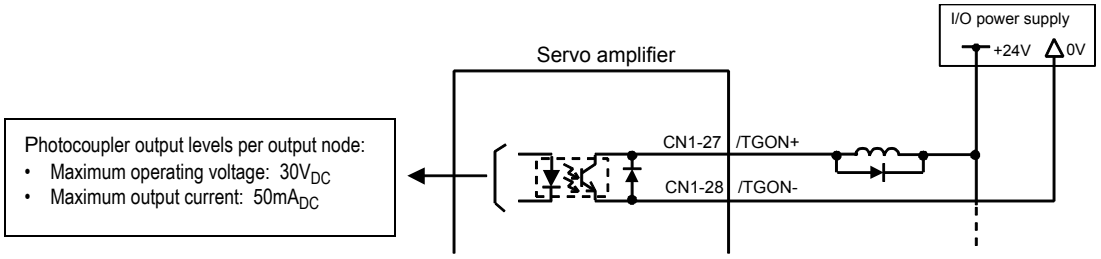
The /V-CMP signal is output when the difference between the speed reference and actual motor speed is below this setting.

Example: The /V-CMP signal turns ON at 1900 to 2100rpm if the parameter is set to 100 and the reference speed is 2000rpm.

Note: /V-CMP is a speed control signal. With the default setting, this signal is used as the positioning completed signal /COIN for position control, and it is always ON for torque control.

5.5.5 Using the Running Output Signal (/TGON)

The basic use and wiring procedures for the running (/TGON) output signal (photocoupler output signal) are described below. The signal can be activated to indicate that the servomotor is currently operating. It is used as an external interlock.



Output /TGON CN1-27	Running Output Signal	Speed/Torque Control, Position Control

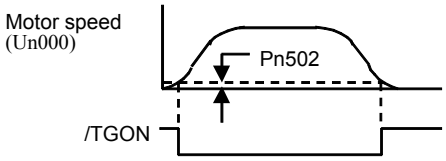
/TGON State	Status	Result
ON	Closed or low level.	Servomotor is operating. (Motor speed is above the setting level).
OFF	Open or high level.	Servomotor is not operating. (Motor speed is below the setting level).

The following parameter setting is used to change the CN1 connector terminal that outputs the /TGON signal.

Parameter	Signal	Setting (rpm)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

The parameter is default set so the /TGON signal is output between CN1-27 and 28. See *5.3.4 Output Circuit Signal Allocation* for more details on parameter Pn50E.

This parameter is used to set output conditions for the operation detection output signal /TGON.



Parameter	Signal	Setting (rpm)	Description
Pn502	Rotation Detection Level	Setting Range: 1 to 10000 Default Setting: 20	Speed/Torque Control, Position Control

This parameter is used to set the speed at which the servo amplifier determines that the servomotor is running and then to output an appropriate signal. The following signals are generated when motor speed exceeds the preset level.

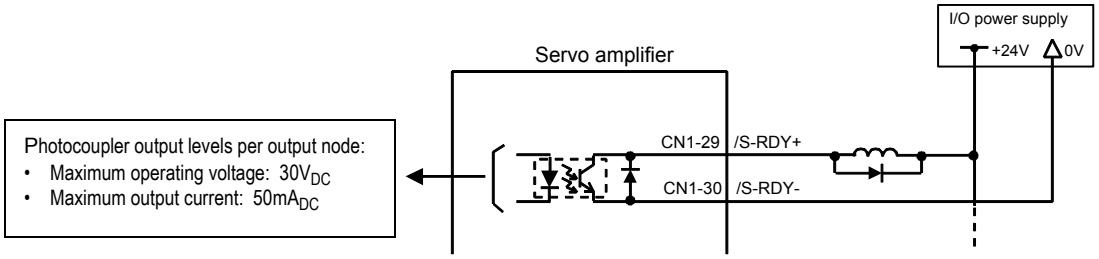
Signals generated when servomotor operation is detected:

- /TGON
- Status Indication Mode
- Monitor Mode Un006

5.5.6 Using the Servo Ready Output Signal (/S-RDY)

The basic use and wiring procedures for the Servo Ready (/S-RDY) output signal (photocoupler output signal) are described below.

Servo Ready means there are no servo alarms and the main circuit power supply is turned ON. An added condition with absolute encoder specifications is that the SEN signal is at high level and absolute data was output to the host controller.



Output /S-RDY CN1-29	Servo Ready Output Signal	Speed/Torque Control, Position Control

This signal indicates that the servo amplifier has completed all preparations and is ready to receive the Servo ON signal.

/S-RDY State	Status	Result
ON	Closed or low level.	Servomotor is ready.
OFF	Open or high level.	Servomotor is not ready.

The following parameter setting is used to change the CN1 connector terminal that outputs the /S-RDY signal.

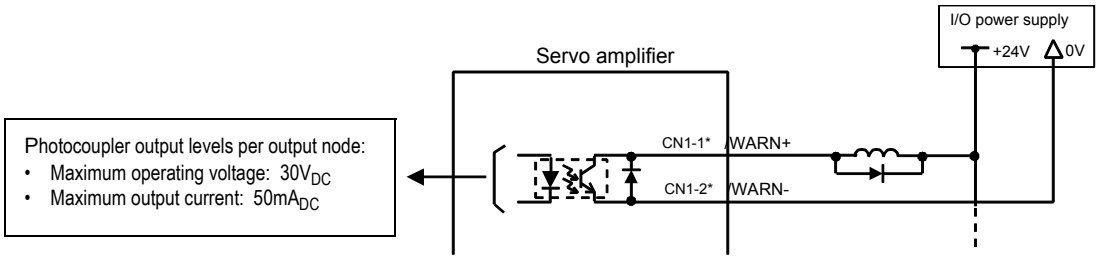
Parameter	Signal	Setting)	Description
Pn50E	Output Signal Selections 1	Default Setting: 3211	Position Control

The parameter is factory set so the /V-CMP signal is output between CN1-29 and 30. See *5.3.4 Output Circuit Signal Allocation* for more details on parameter Pn50E.

5.5.7 Using the Warning Output Signal (/WARN)

The basic use and wiring procedure for the warning (/WARN) output signal (photocoupler output signal) are given below.

The signal consists of the following two output signals.



Note: *CN1-1 and CN1-2 terminals are allocated using parameter Pn50F.3.

Output /WARN	Warning Output Signal	Speed/Torque Control, Position Control

This output signal indicates an overload or regenerative overload warning.

/WARN State	Status	Result
ON	Closed or low level.	Error warning.
OFF	Open or high level.	Normal operation. No warning.

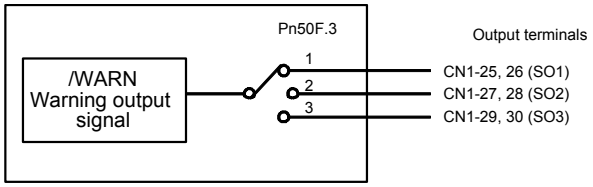
The following parameter setting is used to change the CN1 connector terminal that outputs the /WARN signal.

Parameter	Signal	Setting	Description
Pn50F	Output Signal Selections 2	Default Setting: 0000	Speed/Torque Control, Position Control

Pn50F.3 is used to allocate the /WARN output signals above.

Pn50F.3 State	Output Terminal (CN1-)	
	*1	*2
0	—	—
1	25	26
2	27	28
3	29	30

Notes: *1 and *2 are output terminals allocated with parameter Pn 510.0.
Multiple signals allocated to the same output terminal follow Boolean OR logic. In order to use the /WARN output signal alone, set other output signals to a value other than that allocated to the /WARN signal. See *5.3.4 Output Circuit Signal Allocation.*



The following parameter is used to output warning details with an alarm code.

Parameter	Signal	Setting	Description
Pn001.3	Warning Code Output Selection	Default Setting: 0	Speed/Torque Control, Position Control

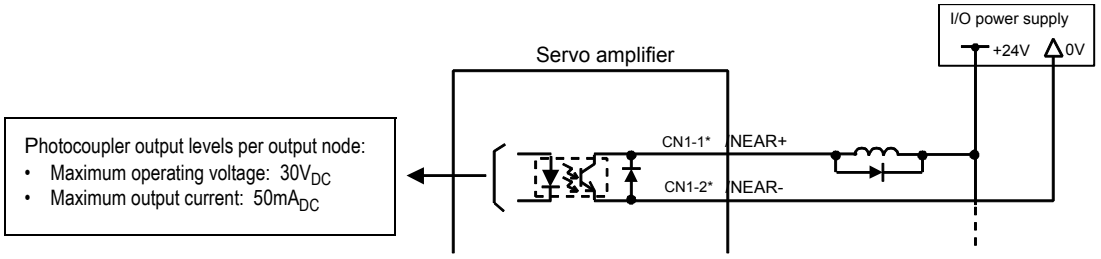
Pn001.3 Setting	Result
0	Outputs alarm codes alone for alarm codes ALO1, ALO2 and ALO3.
1	Outputs both alarm and warning codes for alarm codes ALO1, ALO2 and ALO3 and outputs an alarm code when an alarm occurs.

The following warning codes are output in 3 bits.

Warning Indication	Warning Code Output			Warning Description
	ALO1	ALO2	ALO3	
A.91	ON signal (low level)	OFF signal (high level)	OFF signal (high level)	Overload
A.92	OFF signal (high level)	ON signal (low level)	OFF signal (high level)	Regenerative overload

5.5.8 Using the Near Output Signal (/NEAR)

The basic use and wiring procedures for the near (/NEAR) output signal (photocoupler output signal) are described below. The signal is a sequence signal that is generally output together with the positioning completed signal (/COIN), and it is used to indicate the servomotor is close to completing operation.



Note: *CN1-1 and CN1-2 terminals are allocated using parameter Pn510.0.

Output /NEAR	Near Output Signal	Position Control

The host controller can use the /NEAR signal to prepare the next motion sequence before receiving the positioning completed signal. This reduces the time required to complete the desired motion profile.

/NEAR State	Status	Result
ON	Closed or low level.	The servomotor has nearly completed operation. (Position error is below the near signal setting range.)
OFF	Open or high level.	The servomotor is not close to completing operation. (Position error is above the near signal setting range.)

To use the /NEAR signal, an output terminal must be allocated with the parameter below.

Parameter	Signal	Setting	Description
Pn510	Output Signal Selections 3	Default Setting: 0000	Position Control

Pn510.0 is used to allocate the /NEAR output signals above.

Pn510.0 State	Output Terminal (CN1-)	
	1	2
0	—	—
1	25	26
2	27	28
3	29	30

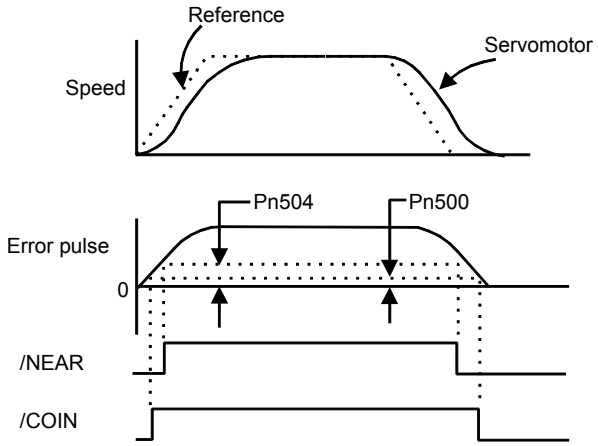
Notes: *1 and *2 are output terminals allocated with parameter Pn 510.0.
Multiple signals allocated to the same output terminal follow Boolean OR logic. In order to use the /WARN output signal alone, set other output signals to a value other than that allocated to the /WARN signal. See *5.3.4 Output Circuit Signal Allocation.*

The following parameter is used to set the timing for /NEAR signal output.

Parameter	Signal	Setting (reference unit*)	Description
Pn504	/NEAR Signal Width	Setting Range: 1 to 250 Default Setting: 7	Position Control

*The number of input pulses defined using the electronic gear function.

Generally set the near signal width higher than the positioning completed width. Also see *5.5.3 Using the Positioning Completed Output Signal (/COIN)'*.



5.5.9 Handling Power Loss

The following parameter is used to specify whether to generate an alarm when power loss occurs.

Parameter	Signal	Setting (ms)	Description
Pn509	Momentary Hold Time	Setting Range: 20 to 1000 Default Setting: 20	Speed/Torque Control, Position Control

The servo amplifier turns the servomotor OFF if it detects a voltage drop in the power supply. The default setting of 20ms means that servomotor operation will continue if power is lost for less than 20ms.

In the following instances, however, either a servo alarm is generated or control is lost (equivalent to normal power OFF operation) regardless of the parameter setting.

- When an insufficient voltage alarm (A.41) occurs during power loss with a large servomotor load.
- Loss of the control power supply is equivalent to normal power OFF operation, thus control is lost.

5.6 Selecting a Regenerative Resistor

When the servomotor operates in generator mode, power is returned to the servo amplifier side. This is called regenerative power. The regenerative power is absorbed by charging the smoothing capacitor, but when the capacitor's charging limit is exceeded, the regenerative power is then reduced by the regenerative resistor.

The servomotor is driven in regeneration (generator) mode in the following conditions:

- While decelerating to a stop during acceleration/deceleration operation.
- With a load on the vertical axis.
- During continuous operation with the servomotor driven from the load side (negative load).

The capacity of the servo amplifier's built-in regenerative resistor is designed for short-term operation only, such as the deceleration stop period. Operation under a negative load is not possible.

If the regenerative power exceeds the processing capacity of the servo amplifier, install an external regenerative resistor. The following table shows the specifications of the servo amplifier's built-in resistor and the amount of regenerative power (average values) that it can process.

Applicable Servo Amplifiers		Built-in Resistor Specifications		Regenerative Power Processed by Built-in Resistor*1 (W)	Minimum Allowable Resistance (Ω)
		Resistance (Ω)	Capacity (W)		
Single-phase, 100V	SGDH-A3BE to -02BE	—	—	—	40
Single-phase 200V	SGDH-A3AE to -04AE	—	—	—	40
	SGDH-08AE-S	50	60	12	
	SGDH-15AE-S	25	140	28	20
Three-phase 200V	SGDH-05AE to -10AE	50	60	12	40
	SGDH-15AE	30	70	14	20
	SGDH-20AE	25	140	28	12
	SGDH-30AE	12.5			
	SGDH-50AE	8	280	56	8
	SGDH-60AE	(6.25)*2	(880)*2	(180)*2	5.8
	SGDH-75AE to -1EAE	(3.13)3)	(1760)3)	(350)3)	2.9
Three-phase 400V	SGDH-05DE to -15DE	108	70	14	73
	SGDH-20DE to -30DE	45	140	28	44
	SGDH-50DE	32	180	36	28
	SGDH-60DE to -75DE	(18)4)	(880)4)	(180)4)	18
	SGDH-1ADE to -1EDE	(14.25)5)	(1760)5)	(350)5)	14.2

*1 The amount of regenerative power (average value) that can be processed is rated at 20% of the capacity of the servo amplifier's built-in regenerative resistor.

*2 The values in parentheses are for the optional JUSP-RA04 Regenerative Resistor Unit.

*3 The values in parentheses are for the optional JUSP-RA05 Regenerative Resistor Unit.

*4 The values in parentheses are for the optional JUSP-RA18 Regenerative Resistor Unit.

*5 The values in parentheses are for the optional JUSP-RA19 Regenerative Resistor Unit.

When installing an external regenerative resistor, make sure that its resistance is equivalent to that of the servo amplifier's built-in resistor. If combining multiple small-capacity regenerative resistors to increase the regenerative resistor capacity (W), select resistors so that the resistance value, including error, equals or exceeds the minimum allowable resistance shown in the above table.

5.6.1 External Regenerative Resistor

When installing an external regenerative resistor, a parameter setting must be changed as shown below.

Parameter	Signal	Setting (x 10W)	Description
Pn600	Regenerative Resistor Capacity	Setting Range: 0 to maximum Default Setting: 0	Speed/Torque Control, Position Control

The default setting of "0" in the above table is the set value when the servo amplifier's built-in resistor is used or when a servo amplifier without a built-in resistor is used.

When installing an external regenerative resistor, set the regenerative resistor's capacity (W).

Example: When the external regenerative resistor's actual consumable capacity is 100W, set the parameter to "10" (10 x 10W = 100W).
When using a JUSP-RA14 external resistor pack rated at 4800 watts, set Pn600 to 240 if there is forced air cooling for the resistor. Set Pn600 to 96 if natural convection cooling is used. For details, see notes 1 and 2 below.

Notes: 1. In general, when resistors for power are used at the rated load ratio, the resistor temperature increases to between 200°C and 300°C. The resistors must be used at or below the rated values. Check with the manufacturer for the resistor's load characteristics. Use resistors at no more than 20% of the rated load ratio with natural convection cooling, and no more than 50% of the rated load ratio with forced air cooling. Parameter Pn600 must be set for the derated resistor.

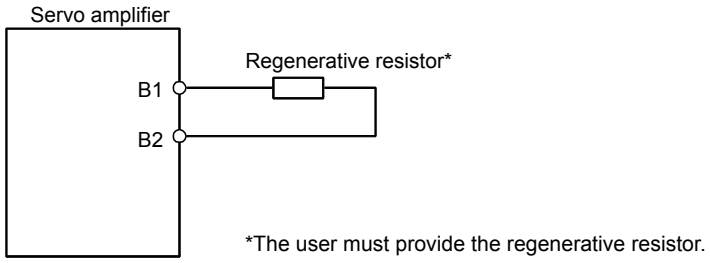
2. Use of resistors with thermal switches is recommended as a safety precaution.

■ Connecting Regenerative Resistors

The method for connecting regenerative resistors is shown below.

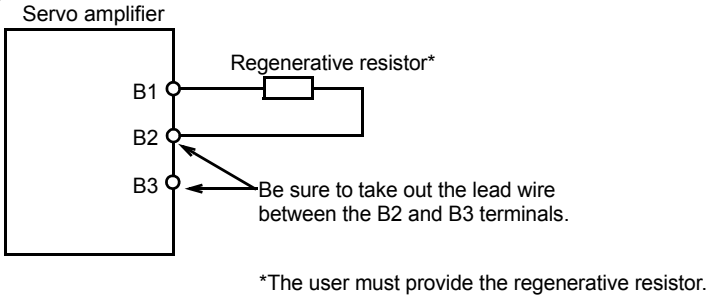
Servo Amplifier Capacity of 400W or Less

Connect an external regenerative resistor between the servo amplifier's B1 and B2 terminals.



Servo Amplifier Capacity of 0.5 to 5.0kW

Disconnect the wire between the servo amplifier's B2 and B3 terminals and connect an external regenerative resistor between the B1 and B2 terminals.



Servo Amplifier Capacity of 6.0kW or More

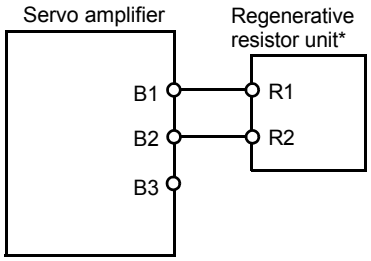
Servo amplifiers with capacities of 6.0kW or more do not have built in regenerative resistors, so an external unit is required. The following regenerative resistor units are designed to meet this need. Parameter Pn600 must be set to identify the external unit's capacity (with appropriated derating).

Servo Amplifier	Applicable Regenerative Resistor Unit	Resistance Ω	Specifications
SGDH-60AE	JUSP-RA04	6.25	25Ω (220W) × 4 resistors in parallel
SGDH-75AE to 1EAE	JUSP-RA05	3.13	25Ω (220W) × 8 resistors in parallel
SGDH-60DE to 75DE	JUSP-RA18	18	18Ω (220W) × 4 resistors in series-parallel
SGDH-1ADE to 1EDE	JUSP-RA19	14.25	28.5Ω (220W) × 8 resistors in series-parallel

Use one of the following resistor unit for the large capacity amplifiers (22-55kW).

Servopack Model SGDH-	2BDE	3ZDE	3GDE	4EDE	5EDE
Regenerative Resistor Unit JUSP	RA12	RA13	RA14	RA15	RA16
Resistance	9Ω	6.7Ω	5Ω	4Ω	3.8Ω
Resistance Capacity	3600W	3600W	4800W	6000W	7200W
Allowable Load Moment of Inertia	5 times the load moment of inertia at motor shaft.				
Allowable Duty	2% ED at maximum speed and torque deceleration.				

Connect the servo amplifier and regenerative resistor unit as shown in the following diagram.



*The user must provide the regenerative resistor.

Note: Adequate cooling must be provided for regenerative resistors because they reach very high temperatures. Also use heat-resistant, non-flammable wire and make sure that the wiring does not come into contact with the resistors.

5.6.2 Calculating the Regenerative Power Capacity

■ Simple Calculation Method

When driving a servomotor normally along the horizontal axis, check the external regenerative resistor requirements using the calculation method shown below.

Servo Amplifiers with Capacity of 400W or Less

Servo amplifiers with a capacity of 400W or less do not have built-in regenerative resistors. The energy that can be absorbed by capacitors is shown in the following table. If the rotational energy in the servo system exceeds these values, then connect a regenerative resistor externally.

Voltage	Applicable Servo Amplifiers	Regenerative Energy that Can be Processed (joules)	Comments
100V	SGDH-A3BE	7.8	Value when the input voltage is $100V_{AC}$
	SGDH-A5BE to -02BE	15.7	
200V	SGDH-A3AE, -A5AE	18.5	Value when the input voltage is $200V_{AC}$
	SGDH-01AE to -04AE	37.1	

Calculate the rotational energy in the servo system using the following equation:

$$E_S = \frac{J \times (N_M)^2}{182} \text{ Joules}$$

Where: $J = J_M + J_L$

J_M: Servomotor rotor inertia ($kg\text{-}m^2$)

J_L: Motor axis conversion load inertia ($kg\text{-}m^2$)

N_M: Rotation speed of the servomotor (rpm)

Servo Amplifier Capacity of 0.5 to 5.0kW

Servomotors with a capacity of 500W to 5kW have built-in regenerative resistors. The allowable frequencies for just the servomotor during acceleration/deceleration operation, in the run cycle from 0 to maximum rotation speed to 0, are summarized in the following table.

Convert the data into the values obtained with actual rotation speed used and load inertia to determine whether an external regenerative resistor is needed.

Voltage	Series / Capacity Symbol	Allowable Frequencies in Regeneration Mode (cycles/min)								
		03	05	08	09	10	13	15	20	30
200V	SGMAH	—	—	89	—	—	—	—	—	—
	SGMPH	—	—	29	—	—	—	17	—	—
	SGMGH-□A□A		34	—	13	—	10	—	12	8
	SGMSH	—	—	—	—	39	—	31	48	20
400V	SGMGH	—	42	—	15	—	10	—	12	8
	SGMSH	—	—	—	—	47	—	31	48	20
	SGMUH	—	—	—	—	27	—	19	—	13

Voltage	Series / Capacity Symbol	Allowable Frequencies in Regenerative Mode (cycles/min)		
		40	44	50
200V	SGMGH-□A□A	—	11	—
	SGMSH	29	—	22
400V	SGMGH	—	11	—
	SGMSH	29	—	22
	SGMUH	19	—	—

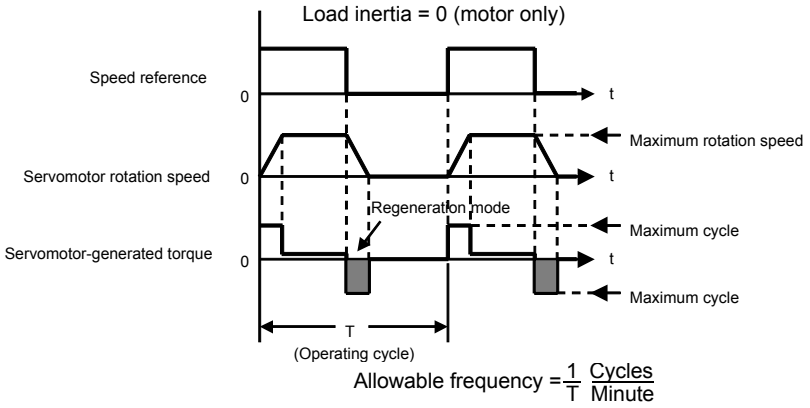
Servo Amplifier Capacity of 6.0kW or More

Servomotors with a capacity of 6.0kW or more do not have built-in regenerative resistors. The following table summarizes the allowable frequencies for the servomotor during regeneration mode, when the servo amplifier is combined with the JUSP-RA04 or JUSP-RA05 Regenerative Resistor Unit.

Voltage	Series / Capacity Symbol	Allowable Frequencies in Regenerative Mode (cycles/min)				
		55	60	75	1A	1E
200V	SGMGH-□A□A	26	—	36	36	32
400V	SGMGH-□D	26	—	18	36	32

Use the equation in the following section to calculate the allowable frequency from the servo system's operating conditions and load inertia.

Operating Conditions for Allowable Regenerative Frequency Calculation



Use the following equation to calculate the allowable frequency for regeneration mode operation.

$$\text{Allowable frequency} = \frac{\text{Allowable frequency for servomotor only}}{(1+n)} \times \left(\frac{\text{Max. rotation speed}}{\text{Rotation speed used}}\right)^2 \frac{\text{Cycles}}{\text{Minute}}$$

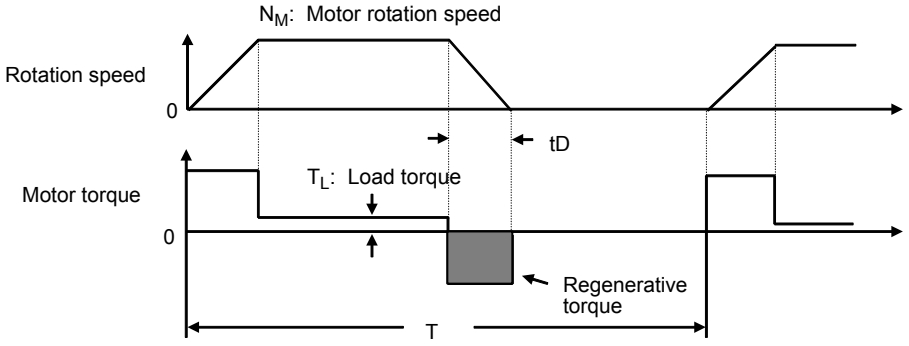
Where: $n = J_L/J_M$

J_L: Motor axis conversion load inertia (kg-m^2)

J_M: Servomotor rotary inertia (kg-m^2)

■ Regenerative Energy Calculation Method

This section shows the procedure for calculating the regenerative resistor capacity when acceleration and deceleration operation is as shown in the following diagram.



Calculation Procedure

The procedure for calculating the capacity is as follows:

Step	Procedure	Units [in. (mm)]	Equation
1	Find the rotational energy of the servo system (E_S).	E_S = [Joules] = [J]= [oz-in-s^2 (kg-m^2-s^2)] J_L = J_M = J N_M = rpm	$E_S = \frac{(J_L + J_M) \times N_M^2}{182}$ Where: N_M = Motor speed J_L = Load Inertia J_M = Motor Inertia
2	Find the energy consumed by load system loss (E_L) during the deceleration period (t_D).	τ_L = oz-in (N-m) E_L = Joules = J N_M = rpm t_D = s	$E_L = \frac{\pi}{60}\left(N_M \times \tau_L \times t_D\right)$ Where: τ_L = Motor torque
3	Calculate the energy lost (E_M) from servomotor winding resistance.	t_D = s = deceleration stopping time E_M = Joules = J	E_M = (Value from the "Servomotor Winding Resistance Loss" graph below) × t_D
4	Calculate the servo amplifier energy (E_C) that can be absorbed.	E_C = Joules = J	E_C = Value from the "Absorbable Servo Amplifier Energy" graph below.
5	Find the energy consumed by the regenerative resistor (E_K).	E_K = E_S =E_L =E_M = E_C = Joules = J	$E_K = E_S - \left(E_L + E_M + E_C\right)$
6	Calculate the required regenerative resistor capacity (W_K).	W_K = W E_K = Joules = J T = s	$W_K = \frac{E_K}{0.2 \times T}$ Where: T = Time

Note: 1. The "0.2" in the equation for calculating W_K is the value for when the regenerative resistor's utilized load ratio is 20%.

If the previous calculation determines that the amount of regenerative power ($W_{Wk.}$) that can be processed by the built-in resistor is not exceeded, then an external regenerative resistor is not required.

If the amount of regenerative power that can be processed by the built-in resistor is exceeded, install an external regenerative resistor for the capacity obtained from the above calculation.

If the energy consumed by load system loss (in step 2 above) is unknown, then perform the calculation using $E_L = 0$.

When the operation period in regeneration mode is continuous, add the following items to the above calculation procedure in order to find the required capacity (W) for the regenerative resistor.

- Energy for continuous regeneration mode operation period: E_G (joules)
- Energy consumed by regenerative resistor: $E_K = E_S - (E_L + E_M + E_C) + E_G$
- Required capacity of regenerative resistor: $W_K = E_K / (0.2 \times T)$

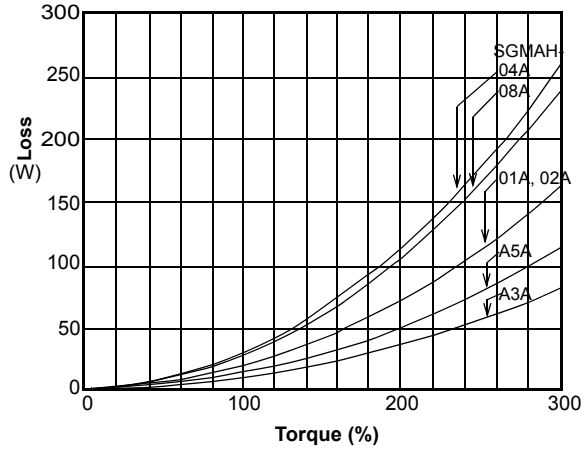
Here, $E_G = (2\pi/60) N_{MG} \times \tau_G \times t_G$

- τ_G: Servomotor's generated torque [oz-in (N-m)] in continuous regeneration mode operation period.
- N_{MG}: Servomotor rotation speed (rpm) for same operation period as above.
- t_G: Same operation period (s) as above.

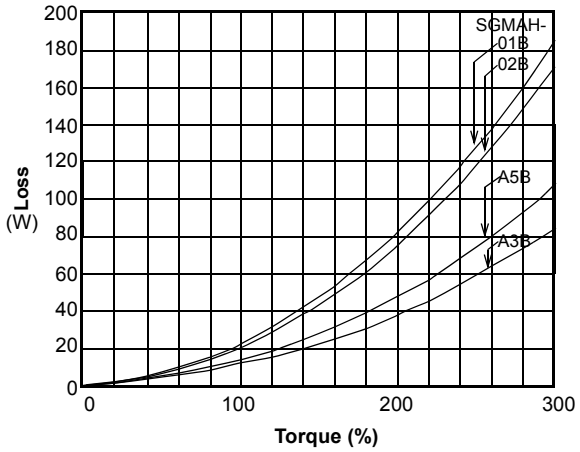
Servomotor Winding Resistance Loss

The following diagrams show the relationship between the generated torque and the winding resistance loss for each servomotor.

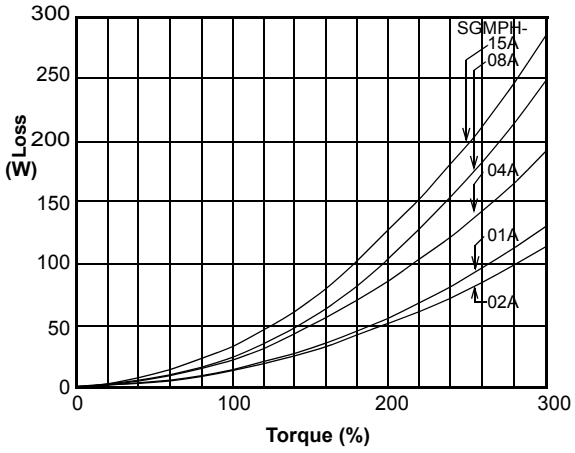
- SGMAH Servomotor, 200V



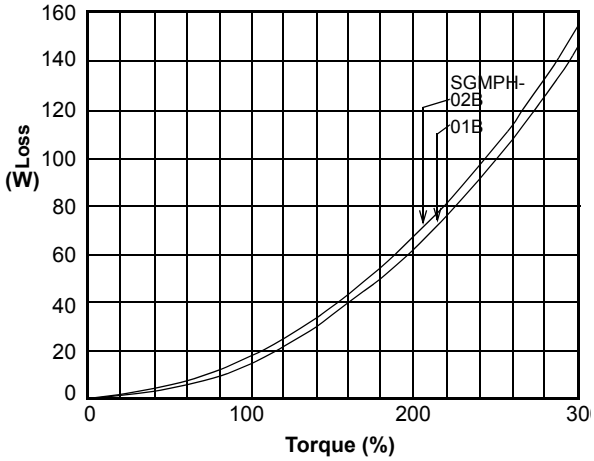
- SGMAH Servomotor, 100V



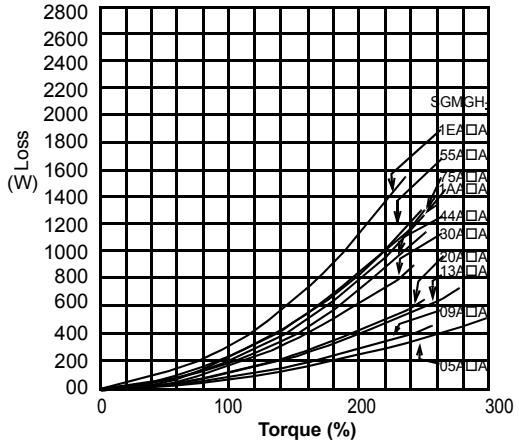
- SGMPH Servomotor, 200V



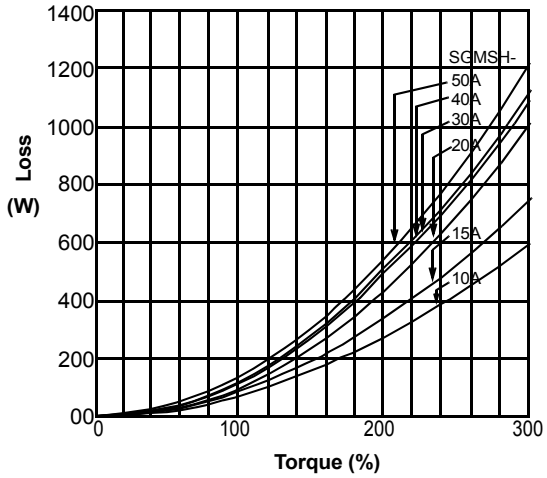
- SGMPH Servomotor, 100V



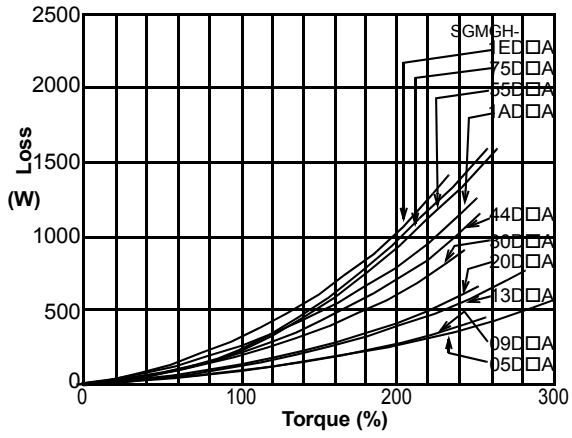
- SGMGH Servomotor, 200V, 1500rpm



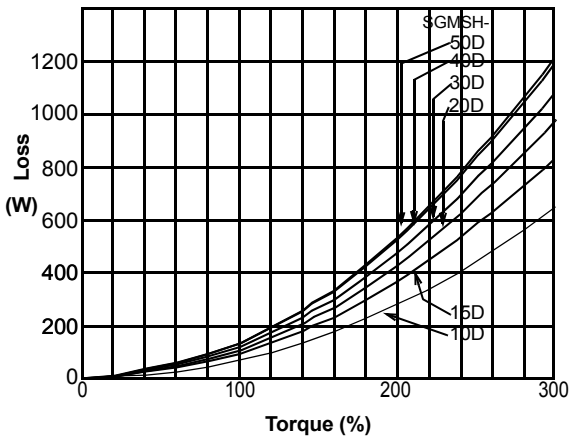
- SGMSH Servomotor, 200V



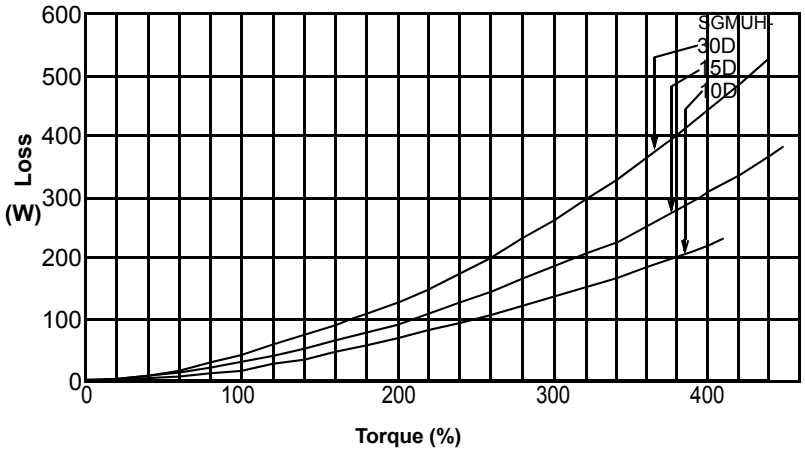
- SGMGH Servomotor, 400V, 1500rpm



- SGMSH Servomotor, 400V



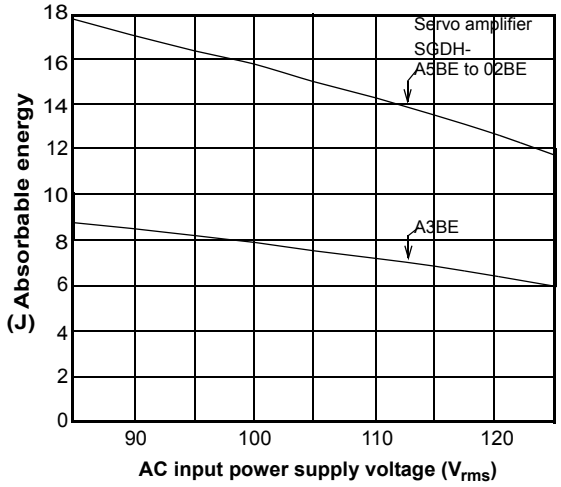
• SGMUH Servomotor, 400V



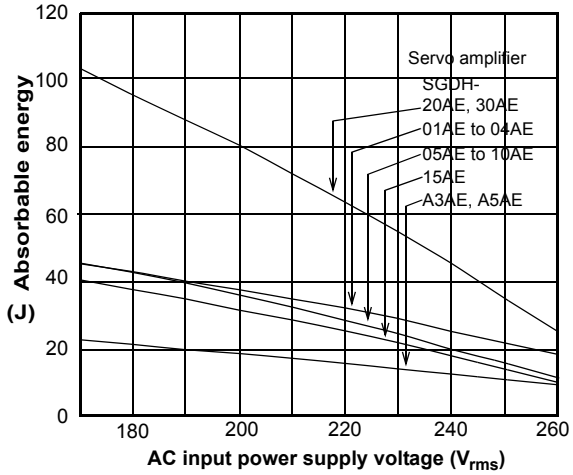
Servo Amplifier's Absorbable Energy

The following diagrams show the relationship between the servo amplifier's input power supply voltage and its absorbable energy.

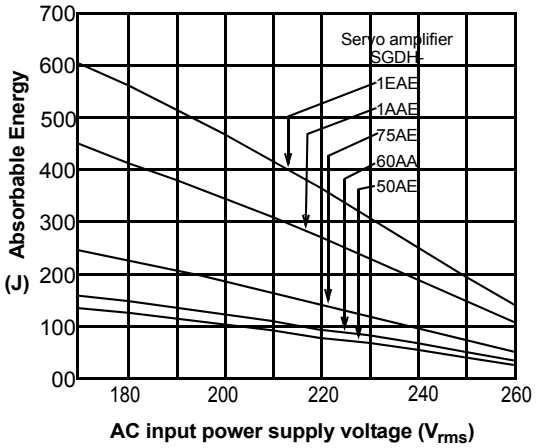
- Servo Amplifier for 100V motor



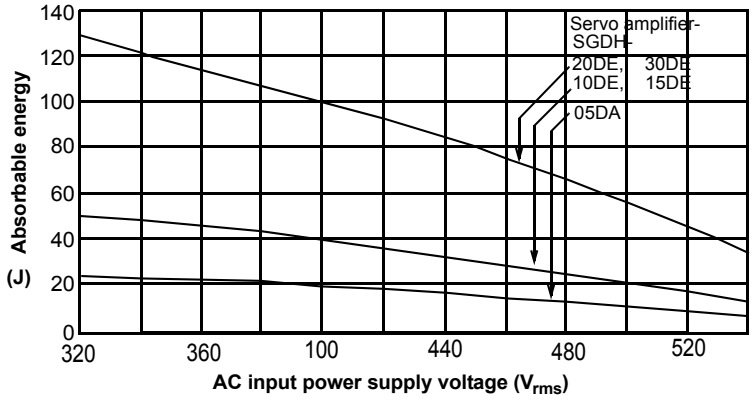
- Servo Amplifier for 200V motor



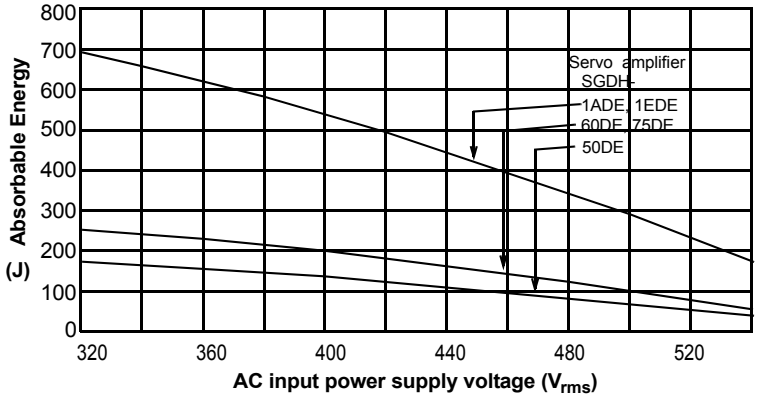
- Servo Amplifier for 200V motor, continued



- Servo Amplifier for 400V motor



- Servo Amplifier for 400V motor, continued

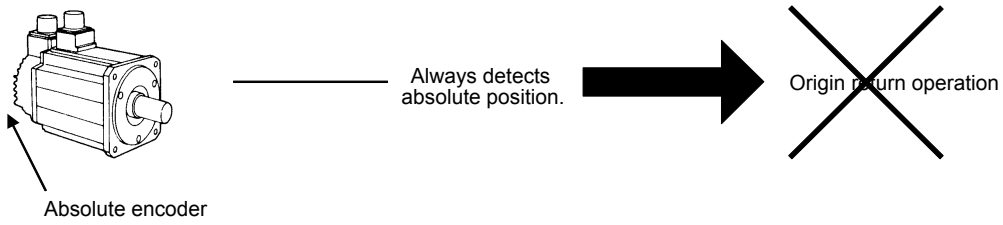


5.7 Absolute Encoders

If a motor with an absolute encoder is used, a system to detect the absolute position can be formed in the host controller. Consequently, automatic operation can be performed without zero return operation immediately after the power is turned ON.

Motor SGM□H-□□□1□···With 16-bit absolute encoder

SGM□H-□□□2□···With 17-bit absolute encoder



⚠ WARNING

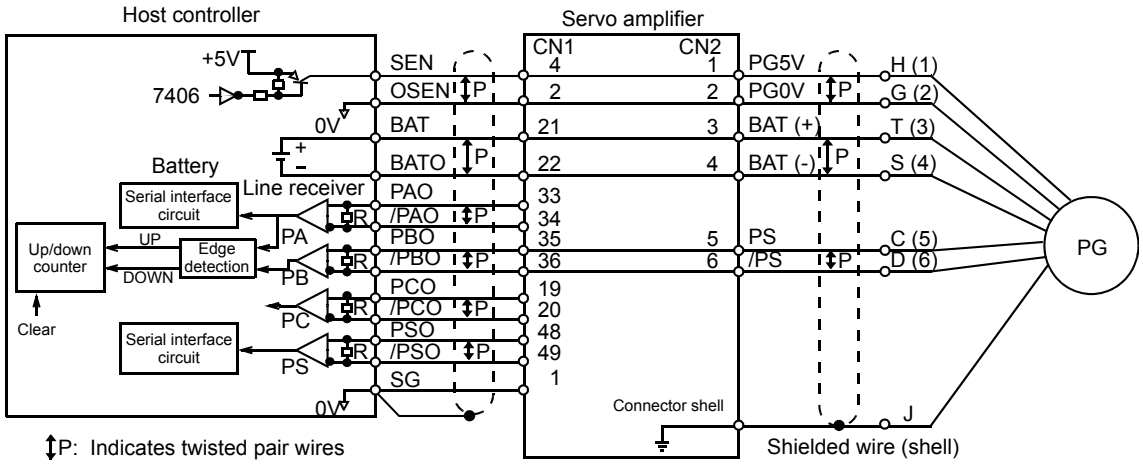
- When using the "Infinite Length Positioning System" be sure to take into account the changes made in the continuous counting method when limits are exceeded, as compared in the following table.
  The output range of multi-turn data for Sigma II series absolute detection system differs from that used in conventional (Sigma) 12- and 15-bit encoder systems.

Absolute Encoder Type	Output Range of Multi-turn Data	When the Output Range Exceeds the Limit:
(Sigma) conventional type 12- and 15-bit encoder	-99999 to +99999	• When the upper limit (+99999) is exceeded in the positive direction, the counter displays 00000 and begins counting up again. • When the lower limit (-99999) is exceeded in the negative direction, the counter displays 00000 and begins counting down again.
Sigma II Series 16- and 17-bit encoder	-32768 to +32767	• When the upper limit (+32767) is exceeded in the positive direction, the counter changes polarity (-32767) and begins counting up (toward zero and beyond). • When the lower limit (-32767) is exceeded in the negative direction, the counter changes polarity (+32767) and begins counting down (toward zero and beyond).

Note: After the limit has been changed in multi-turn limit setting parameter (Pn205), the power must be cycled. This generates a Multi-turn Limit Disagreement Alarm (A.CC). Make sure that the entered value is appropriate before resetting this alarm. For more information see: *5.7.2 Configuring an Absolute Encoder*, and *9.2.1 Troubleshooting Problems with Alarm Displays*.

5.7.1 Interface Circuit

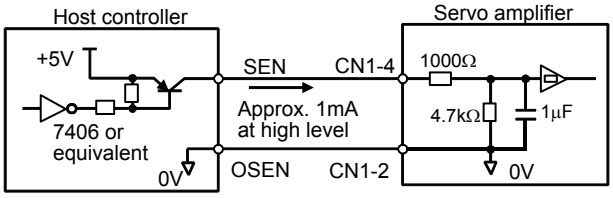
The following diagram shows the standard connections for an absolute encoder mounted to a servomotor.



Applicable line receivers:SN75175 or MC3486 by TI.

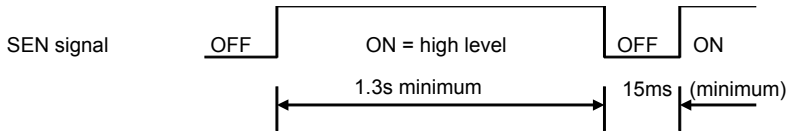
Terminating resistance R:220 to 470Ω

■ SEN Signals



- Wait at least three seconds after turning on the power before raising the SEN signal to high level.
- When the SEN signal is changed from low level to high level, the multi-turn data and initial incremental pulses are transmitted.
- The motor cannot be operated until these operations are completed, regardless of the status of the servo ON signal (/S-ON).

Note: If for some reason it is necessary to turn OFF a SEN signal that is already ON, and then to turn it back ON again, maintain the high level for at least 1.3 seconds before turning it ON and OFF.



5.7.2 Configuring an Absolute Encoder

Select the absolute encoder's application with the following parameter.

Parameter	Signal	Setting	Description
Pn002.2	Absolute Encoder Application	Setting Range: 0 or 1 Default Setting: 0	Speed/Torque Control, Position Control

Either "0" or "1" in the following table must be set in order to enable the absolute encoder.

Pn002.2 Setting	Result
0	Uses the absolute encoder as an absolute encoder.
1	Uses the absolute encoder as an incremental encoder.

The following parameter is used to periodically clear the encoder's counter (return the setting to 0) after a designated ratio of motor to load axis revolutions. This function is called the multi-turn limit.

Note: The term **Multi-turn Limit** refers to the highest number of rotations the encoder's counter will display before returning the counter to 0.

Parameter	Signal	Setting	Description
Pn205	Multi-turn Limit Setting	Setting Range: 0 to 65535 Default Setting: 65535	Speed/Torque Control, Position Control

- When Pn205 is set to the default (65535), multi-turn data varies in the range of –32768 to +32767.
- With any other Pn205 value entered, data varies from 0 to the set value.

Note: To activate reassignment of this value, the user must first enter the change to the parameter, and then cycle (turn OFF and then turn ON) the power.

Since the encoder's multi-turn limit value is set as default to 65535, the following alarm occurs if the servo amplifier's power supply is cycled (turned OFF and ON) after changing parameter Pn205:

Alarm Display	Alarm Code Output			Description
	ALO1	ALO2	ALO3	
A.CC	O	X	O	Encoder multi-turn limit value does not match with that of the servo amplifier.

Note: O: ON ("L") signal
X: OFF ("H") signal

In order to set a multi-turn limit value to the encoder, perform the multi-term limit setting operation (Fn-013).

This operation can be executed using the hand-held digital operator or the servo amplifier panel operator.

Note: The multi-turn limit setting is enabled only during the multi-turn limit value mismatch alarm. Cycle the power after performing this operation.

⚠ WARNING

- **Connect the ground terminal to a class-3 ground (100Ω or less).**
  Improper grounding may result in electric shock or fire.

5.7.3 Handling Batteries

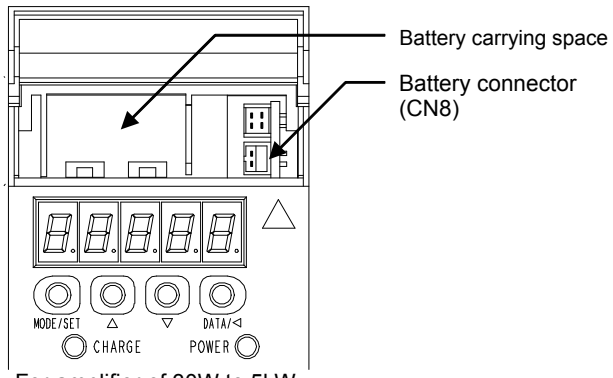
In order for the absolute encoder to retain position data when the power is turned OFF, the data must be backed up by a battery.

■ Installing the Battery at the Host Device

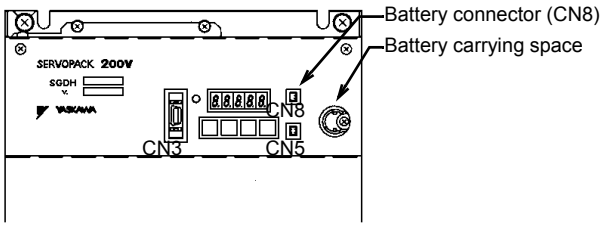
Lithium battery, by Toshiba: ER6VC3, 3.6V, 2000mAh

■ Battery Provided for Servo Amplifier

Lithium battery: JZSP-BA01 (includes battery and connector)
Battery: Toshiba, ER3 V, 3.6V, 1000mAh



For amplifier of 30W to 5kW



For amplifier of 6.0 to 55kW

⚠ WARNING

- **Install the battery at either the host controller or the servo amplifier, NEVER at both simultaneously.**
  Such a connection would create a circuit between the batteries, which could lead to electric shock, injury, or equipment damage.

5.7.4 Absolute Encoder Setup

Perform the setup operation for the absolute encoder in the following circumstances:

- When starting the machine for the first time.
- When an encoder backup alarm is generated.
- When the encoder loses power, often because of cable disconnection.

The setup operation can be performed by using the hand-held digital operator, the servo amplifier's panel operator, or with personal computer monitor software.

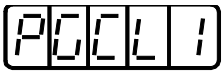
The setup operation procedure shown here uses the digital operator. For more details, refer to *Chapter 7: Using the Digital Operator.*

■ Setup Using the Hand-held Digital Operator

1. Press the **MODE/SET** key to select the auxiliary function mode.

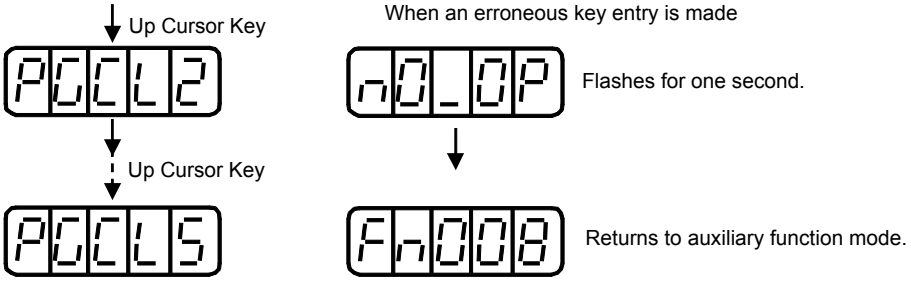
2. Select the user function Fn008. Press the **Left Arrow** ← or **Right Arrow** → key to select the digit to set, and then press the **Up Arrow** ↑ or **Down Arrow** ↓ key to change the number.

3. Press the **DATA/ENTER** key. The following display will appear.

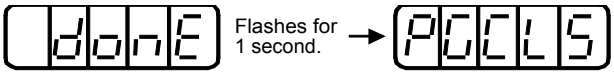


4. Pressing the **Up Arrow** ↑ key will change the display as shown below.

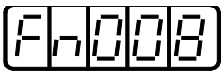
Continue pressing the **Up Arrow** ↑ key until "PGCL5" is displayed. If an erroneous key entry is made, "nO_OP" will flash for one second and the display will return to the auxiliary function mode. In that case, go back to step 3 above and perform the operation again.



5. When "PGCL5" is displayed, press the **MODE/SET** key. The display will change as follows, and the absolute encoder's multi-turn data will be cleared.



6. Press the **DATA/ENTER** key to return to the auxiliary function mode.



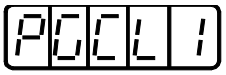
This completes the absolute encoder's setup operation. Cycle the power to the servo amplifier.

■ Setup Using the Built-in Panel Operator

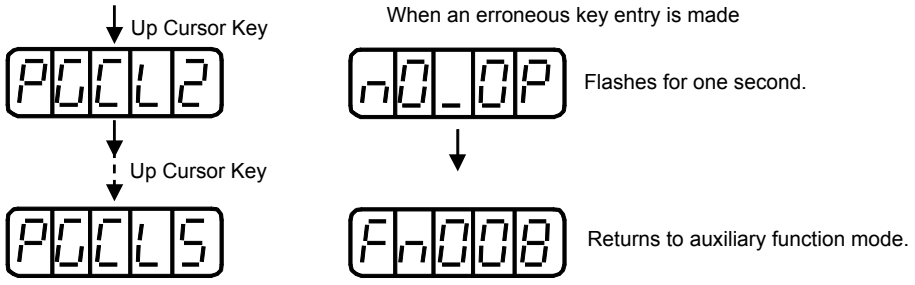
1. Press the **MODE/SET** key to select the auxiliary function mode.

2. Press the **Up Arrow** ↑ or **Down Arrow** ↓ key to select the parameter Fn008.

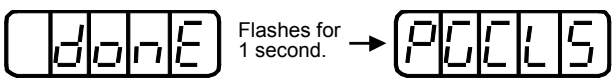
3. Press the **DATA/SHIFT** key, holding it down for at least one second. The following display will appear.



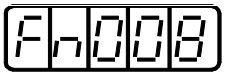
4. Press the **Up Arrow** ↑ key, holding it down until "PGCL5" is displayed. If an erroneous key entry is made, "nO_OP" will flash for one second and the display will return to the auxiliary function mode. In that case, go back to step 3 above and perform the operation again.



5. When "PGCL5" is displayed, press the **MODE/SET** key. The display will change as follows, and the absolute encoder's multi-turn data will be cleared .



6. Press the **DATA/SHIFT** key to return to the auxiliary function mode.



This completes the absolute encoder's setup operation. Cycle the power to the servo amplifier.

Note: If the following absolute encoder alarms are displayed, the alarms must be cleared using the method described above for the setup operation. They cannot be cleared by the servo amplifier's alarm reset (/ARM-RST) input signal.

- Encoder backup alarm (A.81)
- Encoder check sum alarm (A.82)

In addition, if a monitoring alarm is generated in the encoder, the alarm must be cleared by turning OFF the power.

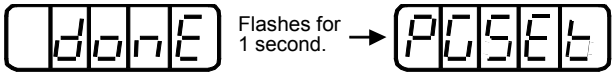
■ Multi-turn Setup Using the Hand-held Digital Operator

1. Press the **MODE/SET** key to select the auxiliary function mode.

2. Select the user function Fn013. Press the **Left Arrow** ← or **Right Arrow** → key to select the digit to set, and then press the **Up Arrow** ↑ or **Down Arrow** ↓ key to change the number.

3. Press the **DATA/ENTER** key. The following display will appear.

4. Press the **MODE/SET** key. The display will change as follows, and the absolute encoder's multi-turn data will be cleared.

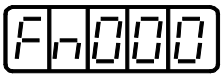


5. Press the **DATA/ENTER** key to return to the auxiliary function mode.

This completes the absolute encoder's multi-turn limit setting operation. Cycle the power.

■ Multi-turn Setup Using the Built-in Panel Operator

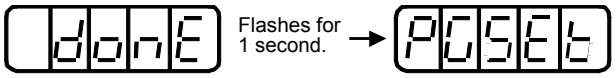
1. Press the **MODE/SET** key to select the auxiliary function mode.



2. Press the **Up Arrow** ↑ or **Down Arrow** ↓ key to select the parameter Fn013.

3. Press the **DATA/SHIFT** key. The following display will appear.

4. Press the **MODE/SET** key. The display will change as follows, and the absolute encoder's multi-turn limit setting operation will be performed.



5. Press the **DATA/SHIFT** key to return to the auxiliary function mode.

This completes the absolute encoder's multi-turn limit setting operation. Cycle the power to the servo amplifier.

⚠ WARNING

- **The multi-turn limit value should be changed only for special applications**.
  Changing it inappropriately or unintentionally can be dangerous.
- **If the Multi-turn Limit Value Disagreement Alarm occurs, check the setting of parameter Pn205 in the servo amplifier to be sure that it is correct. If Fn013 is executed when an incorrect value is set in Pn205, that same incorrect value will be set in the encoder. There will not be an additional alarm, even if an incorrect value is set, but incorrect positions will be detected.**
  This results in a potentially dangerous situation where the machine will move to an unexpected position.

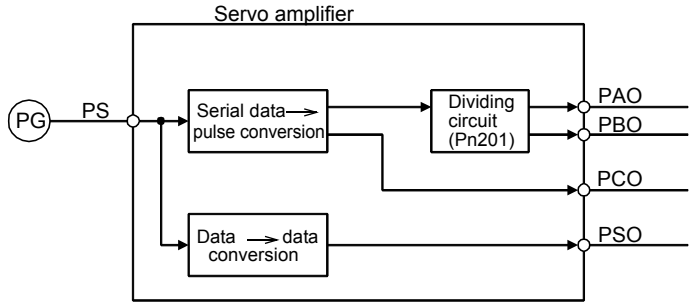
5.7.5 Absolute Encoder Reception Sequence

The sequence in which the servo amplifier receives data from the absolute encoder and transmits them to the host device is shown below.

Be sure you understand this section when designing the host device.

■ Outline of Absolute Signals

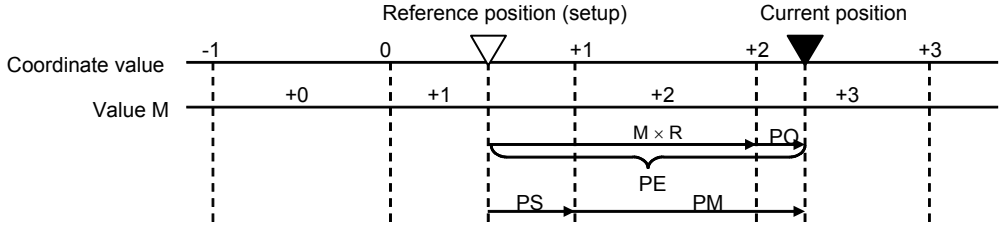
The absolute encoder's outputs are PAO, PBO, PCO, and PSO signals as shown below.



Signal	Status	Contents
PAO	Initial State	Serial data Initial incremental pulse
	Normal State	Incremental pulse
PBO	Initial State	Initial incremental pulse
	Normal State	Incremental pulse
PCO		Home position pulse
PSO		Rotation count serial data

■ Contents of Absolute Data

- Serial data: Indicates how many turns the motor shaft has made from the reference position (position specified at setup).
- Initial incremental pulse: Outputs pulses at the same pulse rate as when the motor shaft rotates from the home position to the current position at approximately 2500rpm (for 16 bits when the dividing pulse is at the default setting).



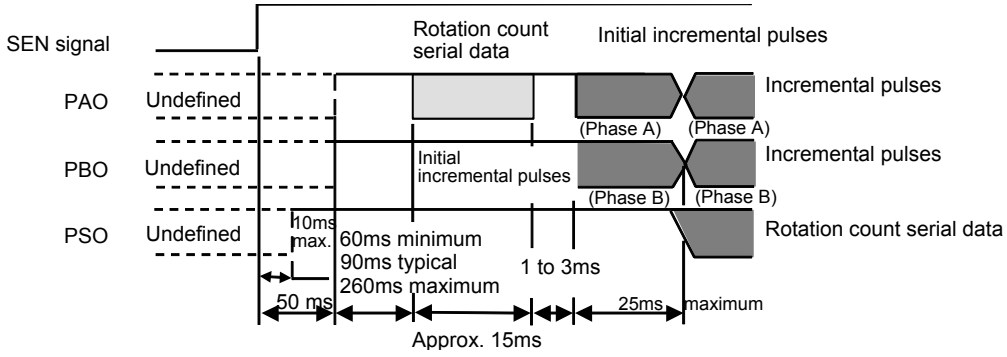
The final absolute data P_M can be found by using the following formulas:

Forward rotation mode: (Pn 000.0 = 0)	$P_E = M \times R + P_O$ $P_M = P_E - P_S$	Reverse rotation mode: (Pn0000.0 = 1)	$P_E = -(M \times R) + P_O$ $P_M = P_E - R_S$

Where: P_E = The current value read by the encoder.
M = The multi-turn data (rotation count data).
P_O = The number of initial incremental pulses.
P_S = The number of initial incremental pulses read at setup. (This is saved and controlled by the host controller).
P_M = The current value required for the user's system.
R = The number of pulses per encoder revolution. (Pulse count after dividing by the value of Pn201)

■ Absolute Encoder Transmission Sequence

1. Set the SEN signal at high level.
2. After 100ms, set the system to serial data reception-waiting-state. Clear the incremental pulse up/down counter to zero.
3. Receive eight bytes of serial data.
4. The system enters a normal incremental operation state approximately 50ms after the last serial data is received.

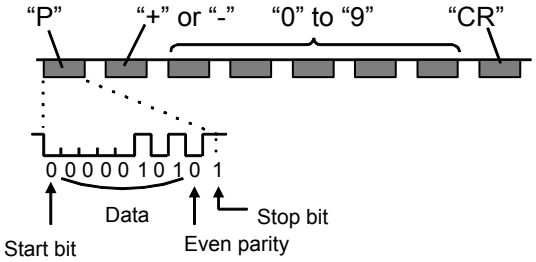


■ Detailed Signal Specifications

PAO Serial Data Specifications

The number of revolutions is output in five digits.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	8 characters, as shown below.



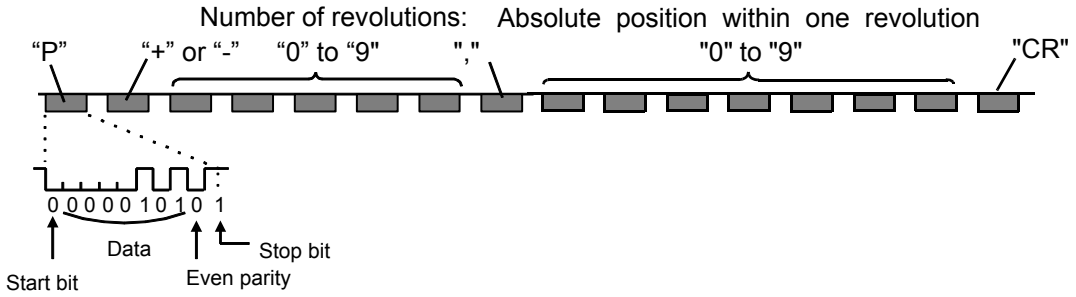
Note: 1. Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero.

2. The revolution range is "+32767" to "-32768." When this range is exceeded, the data changes from "+32767" to "-32768" or from "-32768" to "+32767"

PSO Serial Data Specifications

The number of revolutions and the absolute position within one revolution are always output in five and seven digits, respectively. The data output cycle is approximately 40ms.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	13 characters, as shown below.

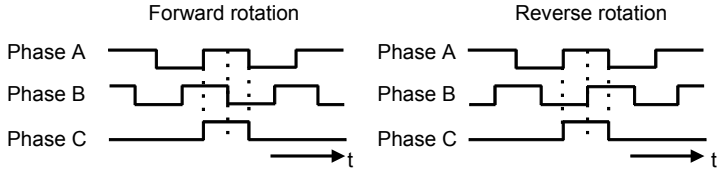


Note: 1. The absolute position data within one revolution is the value before dividing.

2. Absolute position data increases during forward rotation. (Not valid in reverse rotation mode).

Incremental Pulses and Origin Pulses

Just as with normal incremental pulses, initial incremental pulses which provide absolute data are first divided by the frequency divider inside the servo amplifier and then output.



Setting the Pulse Dividing Ratio

Use the following parameter to set the pulse dividing ratio.

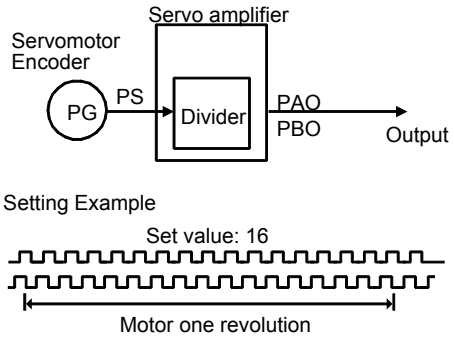
Parameter	Signal	Setting (PPR)	Description
Pn201	PG Divider	Setting Range: 16 to 16384 Default Setting: 16384	Speed/Torque Control, Position Control

This parameter sets the number of output pulses for PG output signals (PAO, /PAO, PBO, /PBO).

Pulses from the motor encoder (PG) are divided by the number of pulses set here before being output.

The set value is the number of output pulses per revolution. Set this value according to the reference unit of the machine or controller to be used.

The setting range varies according to the encoder used.



Output terminals:
PAO (CN1-33)
/PAO (CN1-34)
PBO (CN1-35)
/PBO (CN1-36)

■ Transferring Alarm Contents

When an absolute encoder is used, SEN signals can be utilized to transfer the alarm contents through PAO outputs to the host device as serial data.

Alarm Contents Output Example		
SEN Signal	High: Error detection ▼ Low	
Digital Operator Display	run or bb	Absolute encoder backup alarm A81
PAO Serial Data	Incremental pulses	ALM81 CR

Note: Refer to *9.2.3 Alarm Display Table* for a table of alarm contents.

5.8 Special Wiring

This section describes special wiring methods including the one for noise control. In addition to *5.8.1 Wiring Precautions* and *5.8.2 Wiring for Noise Control,* refer to other sections as necessary.

5.8.1 Wiring Precautions

To ensure safe and stable operation, always observe the following wiring precautions:

1. Always use the following cables for reference input and encoder wiring.

	Cable Type	Yaskawa Drawing Number	Maximum Allowable Length	
Reference Input	Twisted pair wires	JZSP-CKI01	118in (3m)	
Encoder	Multi-conductor shielded twisted pair wire	JZSP-CMP00	SGMAH, SGMPH	787in (20m)
		JZSP-CMP02	SGMGH, SGMSH	1969in (50m)

- Trim off the excess portion of the cable to minimize the cable length.

2. For a ground wire, use as large a wire as possible: AWG14(2.0mm^2) or larger.

- At least class-3 ground (100 Ω maximum) is recommended.
- Ground to one point only.
- If the motor is insulated from the machine, ground the motor directly.

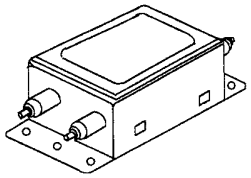
3. Do not bend or apply tension to cables.

The conductor of a signal cable is very thin (0.0079 to 0.012in. (0.2 to 0.3mm)), handle the cables with care.

4. Use a noise filter to prevent noise interference.

(For details, Refer to *5.8.2 Wiring for Noise Control*).

- If the equipment is to be used near private houses or may receive noise interference, install a noise filter on the input side of the power supply line.
- Since this servo amplifier is designed as an industrial device, it provides no mechanism to prevent noise interference.



5. To prevent malfunction due to noise, take the following actions:

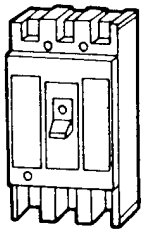
- Position the input reference device and noise filter as close to the servo amplifier as possible.
- Always install a surge absorber circuit in the relay, solenoid, and electromagnetic contactor coils.
- The distance between a power line (such as a power supply line or motor cable) and a signal line must be at least 11.8in (30cm). Do not put the power and signal lines in the same duct or bundle them together.
- Do not share the power supply with an electric welder or electrical discharge machine. When the servo amplifier is placed near a high-frequency oscillator, install a noise filter on the input side of the power supply line.

Notes: 1. Since the servo amplifier uses high-speed switching elements, signal lines may receive noise. To prevent this, always take the above precautions.

2. For details on grounding and noise filters, Refer to *5.8.2 Wiring for Noise Control.*

6. Use a UL listed molded-case circuit breaker (MCCB) or fuse in accordance with the National Electrical Code (NEC) to protect the power supply line from high voltage.

- This servo amplifier connects directly to a commercial power supply without a transformer, so always use an MCCB or fuse to protect the servo system from accidental high voltage.
- Select an appropriate MCCB or fuse according to the servo amplifier capacity and the number of servo amplifiers to be used as shown in the following table.



■ MCCB or Fuse According to Power Capacity

The following table shows the MCCB or fuse capacity for each power supply capacity.

Main Circuit Power Supply	Servo Amplifier Model		Applicable Motor	Power Capacity per Servo Amplifier (kVA)*1	Current Capacity per MCCB or Fuse (A_{rms})*1, *2
	Capacity (kW)	SGDH-			
Single-phase, 100V	0.03	A3BE	SGMAH-A3B	0.15	4
	0.05	A5BE	SGMAH-A5B	0.25	
	0.10	01BE	SGMAH-01B	0.40	
			SGMPH-01B		
	0.20	02BE	SGMAH-02B	0.60	6
			SGMPH-02B		
Single-phase, 200V	0.03	A3AE	SGMAH-A3A	0.20	4
	0.05	A5AE	SGMAH-A5A	0.25	
	0.10	01AE	SGMAH-01A	0.40	
			SGMPH-01A		
	0.20	02AE	SGMAH-02A	0.75	
			SGMPH-02A		
	0.40	04AE	SGMAH-04A	1.2	8
			SGMPH-04A		
	0.75	08AE-S	SGMAH-08A	2.1	11
			SGMPH-08A		
	1.50	15AE-S	SGMPH-15A	4.0	19

*1 This is the net value at the rated load. When actually selecting fuses, determine the capacity with enough margin for peak power operation.

*2 Operating characteristics (at 25°C): 2 seconds or more for 200%, 0.01 second or more for 700%

Notes: 1. A fast-operating fuse cannot be used because the servo amplifier power supply is a capacitor input type. A fast-operating fuse may blow when the power is turned ON.

2. SGDH servo amplifiers do not have built-in ground protection circuits. To configure a safer system, install a ground fault interrupter with or without a circuit breaker for protection against overload and short circuit conditions.

Main Circuit Power Supply	Servo Amplifier Model		Applicable Motor	Power Capacity per Servo Amplifier (kVA)*1	Current Capacity per MCCB or Fuse (A_{rms})*1, *2
	Capacity (kW)	SGDH-			
Three-phase, 200V	0.45	05AE	SGMGH-05A□A	1.4	4
			SGMGH-03A□B		
	0.75	08AE	SGMAH-08A	1.9	7
			SGMPH-08A		
			SGMGH-06A□B		
	1.0	10AE	SGMGH-09A□A	2.3	
			SGMGH-09A□B		
			SGMSH-10A		
	1.5	15AE	SGMPH-15A	3.2	10
			SGMGH-13A□A		
			SGMGH-12A□B		
			SGMSH-15A		
	2.0	20AE	SGMGH-20A□A	4.3	13
			SGMGH-20A□B		
			SGMSH-20A		
	3.0	30AE	SGMGH-30A□A	5.9	17
			SGMGH-30A□B		
			SGMSH-30A		
	5.0	50AE	SGMSH-40A	7.5	28
			SGMGH-44A□A		
			SGMSH-50A		
	6.0	60AE	SGMGH-55A□A	12.5	32
	7.5	75AE	SGMGH-75A□A	15.5	41
	11	1AAE	SGMGH-1AA	22.7	60
	15	1EAE	SGMGH-1EAE	30.9	81

*1 This is the net value at the rated load. When actually selecting fuses, determine the capacity using the prescribed derating.

*2 Operating characteristics (at 25°C): 2 seconds or more for 200%, 0.01 second or more for 700%

Notes: 1. A fast-operating fuse cannot be used because the servo amplifier power supply is a capacitor input type. A fast-operating fuse may blow when the power is turned ON.

2. SGDH servo amplifiers do not have built-in ground protection circuits. To configure a safer system, install a ground fault interrupter with or without a circuit breaker for protection against overload and short circuit conditions.

Main Circuit Power Supply	Servo Amplifier Model		Applicable Motor	Power Capacity per Servo Amplifier (kVA)*1	Current Capacity per MCCB or Fuse (A_{rms})*1, *2
	Capacity (kW)	SGDH-			
Three-phase, 400V	0.45	05DE	SGMGH-05D	1.1	
	1.0	10DE	SGMGH-09D	2.3	3.4
			SGMSH-10D		
			SGMUH-10D		
	1.5	15DE	SGMGH-13D	3.2	4.6
			SGMSH-15D		
			SGMUH-15D		
	2.0	20DE	SGMGH-09D	4.9	7.1
			SGMSH-10D		
	3.0	30DE	SGMGH-30D	6.7	9.7
			SGMSH-30D		
			SGMUH-30D		
	5.0	50DE	SGMGH-44D□A	10.3	14.9
			SGMSH-40D□A		
			SGMSH-50D□A		
			SGMUH-40D□A		
	6.0	60DE	SGMUH-55D□A	12.4	17.8
	7.5	75DE	SGMGH-75D□A	15.4	22.3
	11.0	1ADE	SGMGH-1AD□A	22.6	32.7
	15.0	1EDE	SGMGH-1ED□A	30.9	44.6
	22.0	2BDE	SGMBH-2BD□A	36.7	100
	30.0	3ZDE	SGMBH-3ZD□A	50.1	150
	37.0	3GDE	SGMBH-3GD□A	61.8	150
	45.0	4EDE	SGMBH-4ED□A	75.2	225
	55.0	5EDE	SGMBH-5ED□A	91.9	225

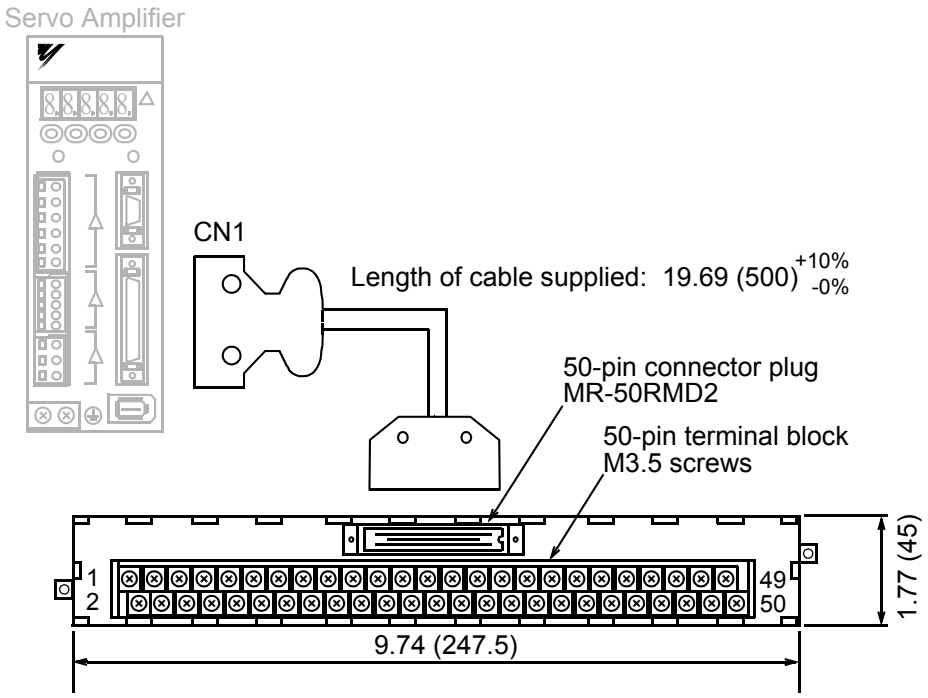
*1 This is the net value at the rated load. When actually selecting fuses, determine the capacity using the prescribed derating.

*2 Operating characteristics (at 25°C): 2 seconds or more for 200%, 0.01 second or more for 700%

Notes: 1. A fast-operating fuse cannot be used because the servo amplifier power supply is a capacitor input type. A fast-operating fuse may blow when the power is turned ON.

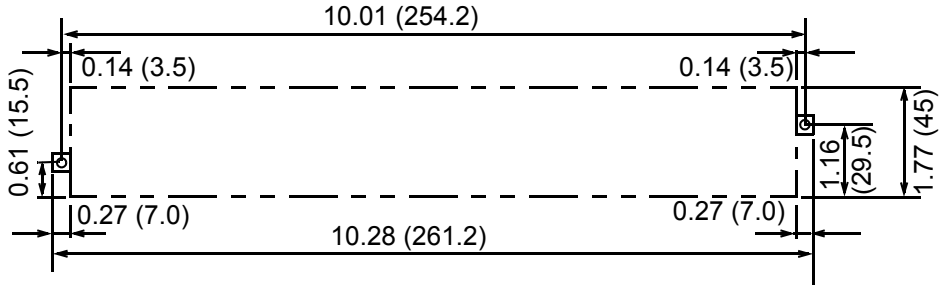
2. SGDH servo amplifiers do not have built-in ground protection circuits. To configure a safer system, install a ground fault interrupter with or without a circuit breaker for protection against overload and short circuit conditions.

■ Connector Terminal Block Converter Unit JUSP-TA50P



Connector Terminal Block Converter Unit
JUSP-TA50P* (cable included)

Mounting Hole Diagram



*Terminal specifications : see the following page

■ JUSP-TA50P Terminal Block Pin Numbers and Signal Names.

SGDH Servo Amplifier				JUSP-TA50P Terminal Block Unit		
Signal Name*		CN1 Pin Number		Connector Number		Terminal Block Number
SG		1		A1		1
SG		2	P	B1		2
PL1		3		A2		3
SEN		4		B2		4
V-REF		5	P	A3		5
SG		6		B3		6
PULS		7	P	A4		7
/PULS		8		B4		8
T-REF		9	P	A5		9
SG		10		B5		10
SIGN		11	P	A6		11
/SIGN		12		B6		12
PL2		13		A7		13
/CLR		14	P	B7		14
CLR		15		A8		15
		16		B8		16
		17		A9		17
PL3		18		B9		18
PCO		19	P	A10		19
/PCO		20		B10		20
BAT (+)		21	P	A11		21
BAT (-)		22		B11		22
		23		A12		23
		24		B12		24
/V-CMP+		25	P	A13		25
/V-CMP-		26		B13		26
/TGON+		27	P	A14		27
/TGON-		28		B14		28
/S-RDY+		29	P	A15		29
/S-RDY-		30		B15		30
ALM+		31	P	A16		31
ALM-		32		B16		32
PAO		33	P	A17		33
/PAO		34		B17		34
BPO		35	P	A18		35
/PBO		36		B18		36
ALO1		37		A19		37
ALO2		38		B19		38
ALO3		39		A20		39
/S-ON		40		B20		40
/P-CON		41		A21		41
P-OT		42		B21		42
N-OT		43		A22		43
/ALM-RST		44		B22		44
/P-CL		45		A23		45
/N-CL		46		B23		46
+24V IN		47		A24		47
PSO		48	P	B24		48
/PSO		49		A25		49
		50		B25		50
Connector Case						

Cable: Supplied with the terminal block

P: Indicates twisted pair wires.

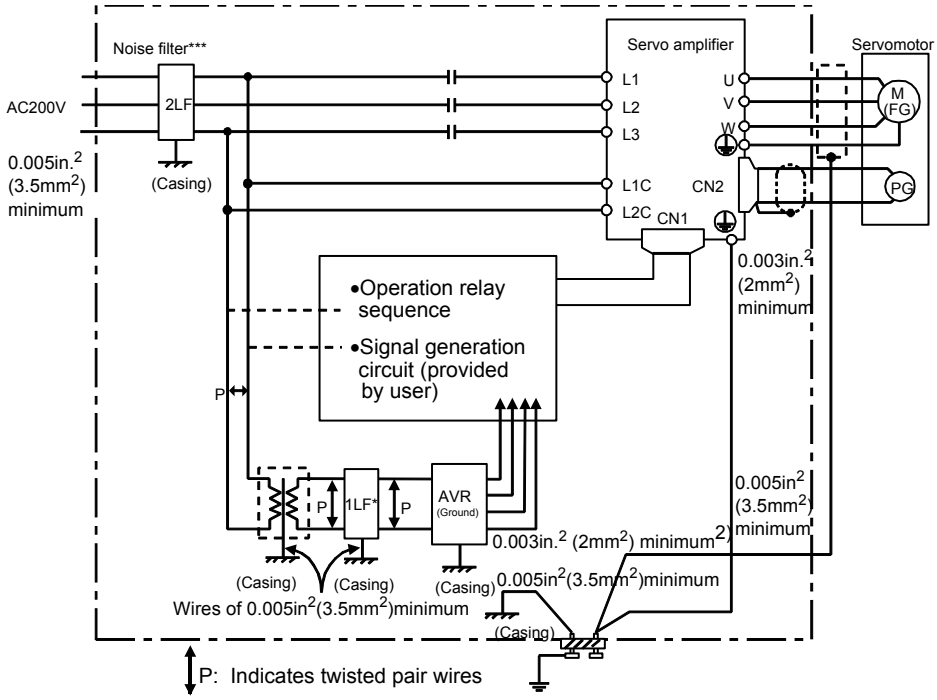
5.8.2 Wiring for Noise Control

■ Wiring Example

This servo amplifier uses high-speed switching elements in the main circuit. It may receive "switching noise" from these high-speed switching elements if wiring or grounding around the servo amplifier is not appropriate. To prevent this, always wire and ground the servo amplifier correctly.

This servo amplifier has a built-in microprocessor (CPU). To protect it from external noise install a noise filter in the appropriate place.

The following is an example of wiring for noise control.



Notes: 1. When using a noise filter, follow the precautions in *Using Noise Filters* on the following page.

2. For ground wires connecting to the casing, use a wire with a thickness of at least 0.005in^2 (3.5mm^2), preferably a braided flat copper wire.

■ Correct Grounding

Grounding the Motor Frame

Always connect servomotor frame terminal FG to the servo amplifier ground terminal ⏚. Also be sure to ground the ground terminal ⏚.

If the servomotor is grounded via the machine, switching noise current will flow from the servo amplifier power unit through motor stray capacitance. The grounding of the motor frame is required to prevent the adverse effects of switching noise.

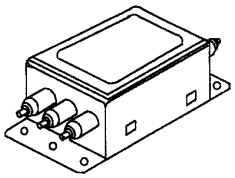
Noise on the Reference Input Line

If the reference input line is affected by noise, ground the 0V line (SG) of the reference input line. If the main circuit wiring for the motor is accommodated in a metal conduit, ground the conduit and its junction box.

All grounds must be made to only one point in the system.

■ Using Noise Filters

Use a noise suppression filter to prevent noise generated by the power supply line. Install a noise filter on the power supply line for peripheral equipment as necessary.



The following table recommends noise filters for each servo amplifier model.

Voltage	Servo Amplifier Model	Recommended Noise Filter	
		Model	Manufacturer
Single-phase, 100V	SGDH-A3AE to -01BE	FN2070-6/07 / FS 5827-4-07	Schaffner
	SGDH-02BE	FN2070-10/07	
Single-phase, 200V	SGDH-A3AE to -02AE	FN2070-6/07 / FS5827-4-07 (New)	
	SGDH-04AE	FN2070-10/07 / FS5827-7-07 (New)	
	SGDH-08AE-S	FN2070-16/07 / FS5827-15-07 (New)	
	SGDH-15AE-S	FN350-30/33 / FS5827-25-07 (New)	
Three-phase, 200V	SGDH-05AE to -20AE	FN258L-7/07	
	SGDH-30AE	FN258L-30/07	
	SGDH-50AE to -60AE	FN258L-42/07	
	SGDH-75AE	FN258L-55/07	
	SGDH-1AAE, -1EAE	FS5559-150-35	
Three-phase, 400V	SGDH-05DE to -15DE	FN258L-7/07 / FS5826-6-07 (New)	
	SGDH-20DE to -30DE	FN258L-16/07 / FS5826-10-07 (New)	
	SGDH-50DE	FS5559-35-33 / FS5826-20-07 (New)	
	SGDH-60DE to -75DE	FS5559-35-33 / FS5826-30-07 (New)	
	SGDH-1ADE to -1EDE	FS5559-80-34 / FS5826-55-07 (New)	
	SGDH-2BDE	FN258L-75-34	
	SGDH-3ZDE	FN258L-100-35	
	SGDH-3GDE	FN258L-130-35	
	SGDH-4EDE	FN258L-180-7	
	SGDH-5EDE	FN258L-180-7	

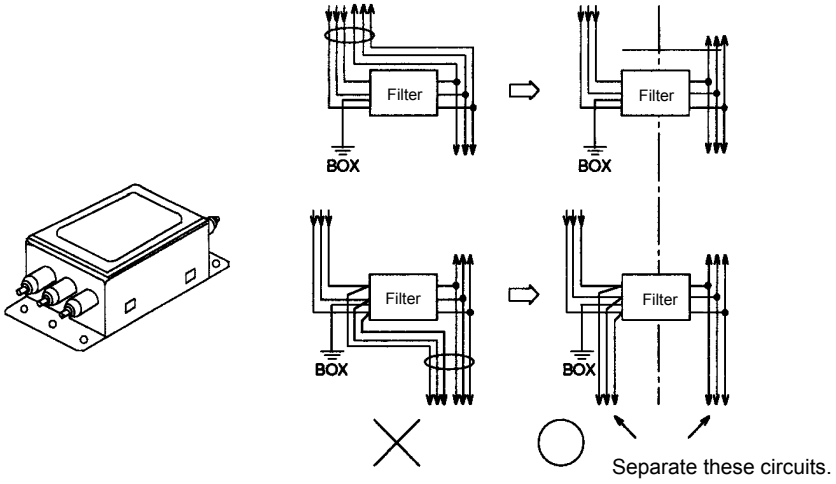
Note: Filters manufactured by Schaffner .

Installation and Wiring a Noise Filter

Incorrect application of a noise filter significantly reduces its benefits. Follow these instructions for the best results.

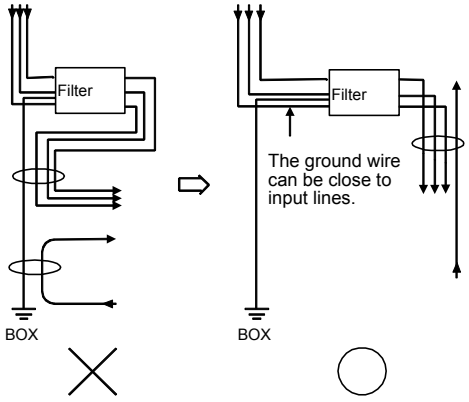
- Separate the input lines from the output lines.

Do not put the input and output lines in the same duct or bundle them together.



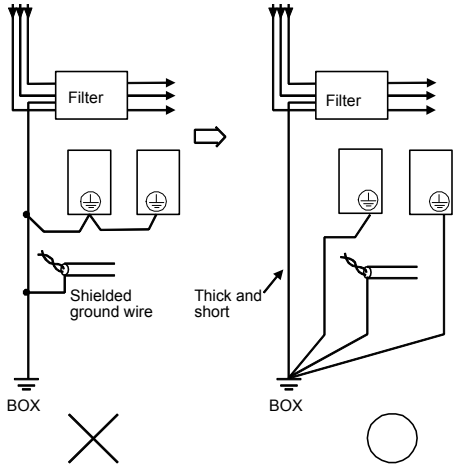
- Isolate the noise filter ground wire from the output lines.

Do not put the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



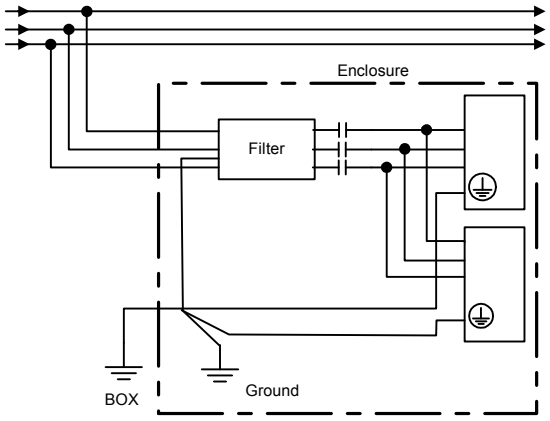
- Connect the noise filter ground wire directly to the ground plate.

Do not connect the noise filter ground wire to other ground wires.



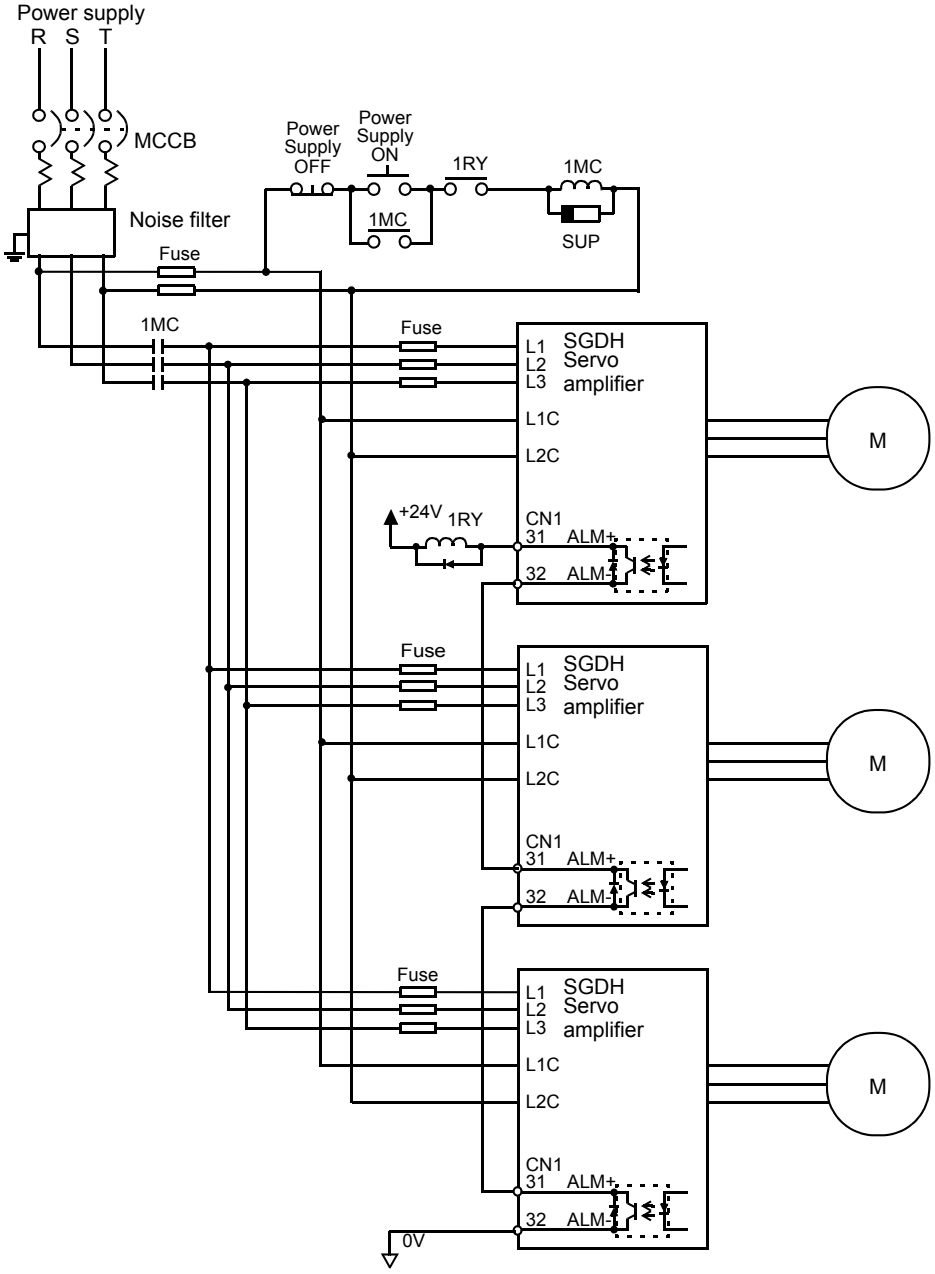
- When grounding a noise filter inside an enclosure:

If a noise filter is located inside an enclosure, connect the noise filter ground wire and the ground wires from other devices inside to the ground plate for the enclosure first, then ground these wires.



5.8.3 Using More Than One Servodrive

The following diagram is an example of the wiring when more than one servodrive is used.



Note: Wire the system to comply to National Electrical Code.

Connect the alarm output (ALM) terminals for the three servo amplifiers in series to enable alarm detection relay 1RY to operate. The output transistor is turned OFF when the ALM output signal enters an alarm state.

Multiple servos can share a single MCCB or noise filter. Always select an MCCB or noise filter that has enough capacity for the total power capacity (load conditions) of

those servos. For details, refer to *5.8.1 Wiring Precautions.*

5.8.4 Extending Encoder Cables

Standard encoder cables have a maximum length of 20m. If a longer cable is required, prepare an extension cable as described below. The maximum allowable cable length is 50m.

Preparing 50m (164.0ft) Encoder Cables

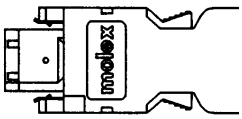
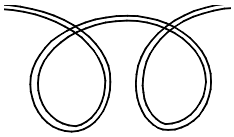
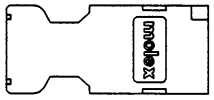
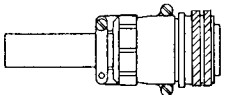
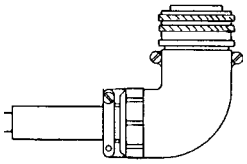
- Cable Model Number: UL20276-SB

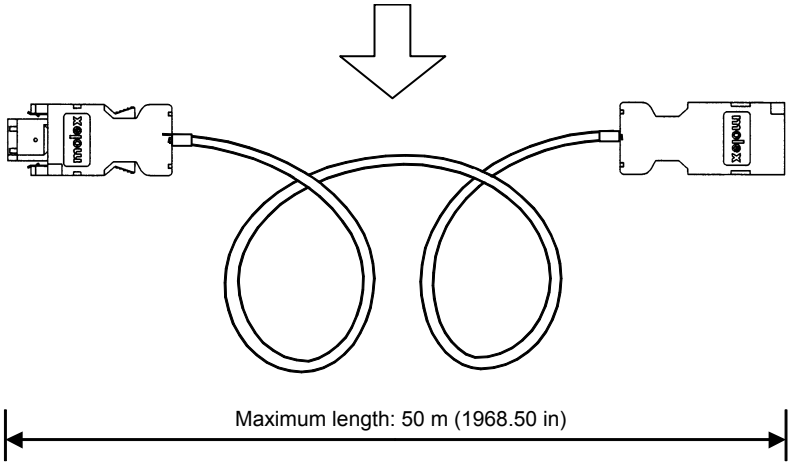
Cables are ordered in units of meters. Specify the length, when ordering.

- Connectors or Connector Kits

Connector Type		Model
Servo amplifier end	Encoder connector (CN2) socket	JZSP-CMP9-1
Servomotor end	Encoder connector socket for SGMAH and SGMPH servomotors	JZSP-CMP9-2
	Encoder connector plug and cable plug for SGMGH and SGMSH servomotors	Plug L: MS3108B20-29S Straight: MS3106B20-29S Cable clamp: MS3057-12A

- Preparing Encoder Cables

• Encoder Connector at Servo Amplifier	• Cable Line	• Encoder Connector at Servomotor	
			For SGMAH and SGMPH servomotors
			For SGMGH, SGMSH, and SGMUH servomotors
			



5.8.5 400V Power Supply Voltage

⚠ CAUTION

- **Do not connect the servo amplifier directly to any voltage level other than what is specified on the servomotor.**
  Doing so will destroy the servo amplifier.

There are four types of SGDH servo amplifiers. The power supply voltages are: single-phase $100V_{ac}$, three-phase $200V_{ac}$, single-phase $200V_{ac}$ and three-phase $400V_{ac}$. For 100V and 200V servo amplifiers that use three-phase $400V_{ac}$ power supply, prepare the following voltage conversion transformers (single-phase or three-phase).

Primary Voltage	Secondary Voltage
$400V_{ac}$ or 440V	$200V_{ac}$
$400V_{ac}$ or 440V	$100V_{ac}$

Refer to the capacities shown in the following table when selecting a voltage conversion transformer.

Voltage	Servo Amplifier Model	Voltage capacity per Servo Amplifier*1 kVA
Single-phase 100V	SGDH-A3BE	0.15
	SGDH-A5BE	0.25
	SGDH-01BE	0.40
	SGDH-02BE	0.60
Single-phase 200V	SGDH-A3AE	0.20
	SGDH-A5AE	0.25
	SGDH-01AE	0.40
	SGDH-02AE	0.75
	SGDH-04AE	1.2
	SGDH-08AE-S	2.1
	SGDH-15AE-S	4.0

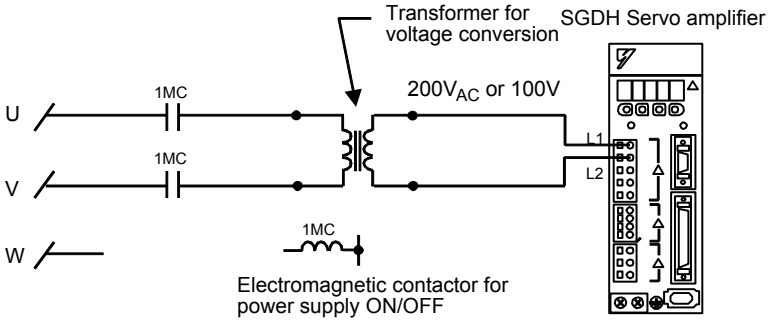
Voltage	Servo Amplifier Model	Voltage capacity per Servo Amplifier*1 kVA
Three-phase 200V	SGDH-05AE	1.4
	SGDH-08AE	1.9
	SGDH-10AE	2.3
	SGDH-15AE	3.2
	SGDH-20AE	4.3
	SGDH-30AE	5.9
	SGDH-50AE	7.5
	SGDH-60AE	12.5
	SGDH-75AE	15.5
	SGDH-1AAE	22.7
	SGDH-1EAE	30.9

*1 This is the net value at the rated load.

When using a 400V class power supply, turn the power supply ON and OFF at the primary side of the voltage conversion transformer.

Note: Transformer inductance will cause a surge voltage if the power is turned ON and OFF at the secondary, damaging the servo amplifier.

Single-phase Power Supply Connection Example

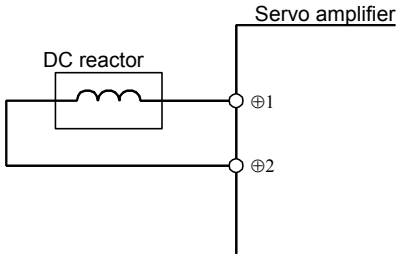


5.8.6 Reactor for Harmonic Suppression

SGDH servo amplifiers have DC reactor connection terminals for power supply harmonic suppression.

■ Connecting a DC Reactor

The DC reactor is connected in series to the rectifier circuit's output side. Refer to *3.2 Servo Amplifier Internal Block Diagrams.*



At the time of shipping, the servo amplifier's (+)1 and (+)2 are short-circuited. Remove the lead wire between the two terminals and connect the DC reactor.

■ DC Reactor Specifications

The following table shows the specifications for the DC reactors provided by Yaskawa.

Applicable Servo Amplifiers		Reactor Specifications		Reactor Model
		Inductance (mH)	Rated current (A)	
Single-phase, 100V	SGDH-A3BE	—	—	—
	SGDH-A5BE	—	—	—
	SGDH-01BE	10.0	1.8	X5063
	SGDH-02BE	4.7	3.5	X5062
Single-phase, 200V	SGDH-A3AE	—	—	—
	SGDH-A5AE	—	—	—
	SGDH-01AE	22.0	1.0	X5071
	SGDH-02AE	10.0	1.8	X5070
	SGDH-04AE	4.7	3.5	X5069
	SGDH-08AE-S	4	4.8	X5079
	SGDH-15AE-S	2.5	10.5	X5078
Three-phase, 200V	SGDH-05AE	2.0	4.8	X5061
	SGDH-08AE			
	SGDH-10AE			
	SGDH-15AE	1.5	8.8	X5060
	SGDH-20AE			
	SGDH-30AE	1.0	14.0	X5059
	SGDH-50AE	0.47	26.8	X5068
Three-phase, 400V	SGDH-05DE	4.7	1.5	X5074
	SGDH-10DE	3.3	4.5	X5075
	SGDH-15DE			
	SGDH-20DE	2.2	8.6	X5076
	SGDH-30DE			
	SGDH-50DE	1.5	14.1	X5077

5.8.7 DB Unit

Large capacity amplifiers (22-55kW) do not have internal DB resistors. An external DB unit is needed if dynamic braking function is required for the application.

Externally attach a DB unit to the amplifier.
This DB unit is used for dissipating motor EMF energy.
The DB unit does not need to be installed if the dynamic brake function is not required.

■ Specifications

Use one of the following DB units according to the Amplifier model.

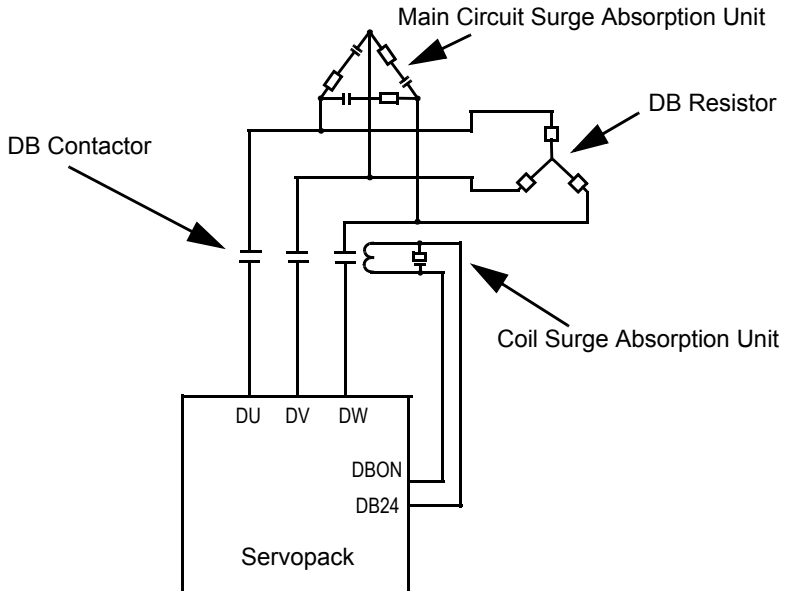
SDGH-	2BDE	3ZDE	3GDE	4EDE	5EDE
Regenerative DB Unit JUSP-	DB03		DB04	DB05	DB06
DB contactor and surge absorbtion unit	Built into Amplifier		Built into DB unit		
Resistance	0.8Ω				
Resistance Capacity	180W				300W
Allowable Load Moment of Inertia	5 times the load moment of inertia at motor shaft.				
Allowable Duty	Less than 1 time/H at maximum speed DB operation.				

■ External Mounted DB Contactor Specification

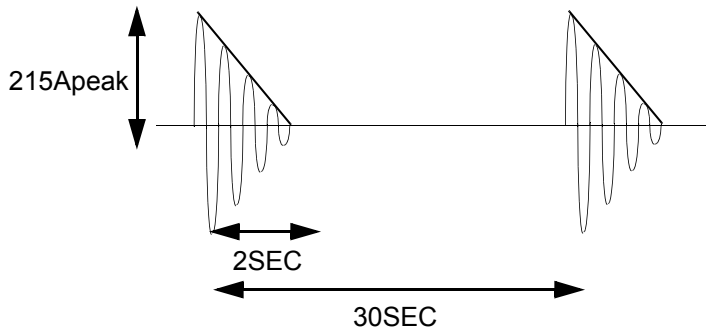
Model		SC-4-1/G DC24V
Maker		Fuji Electric Co. , Ltd.
Standard Coil Voltage		DC24V
Coil Resistance		90W ±10%
Operating Time	Coil ON contactor ON	44~48mSEC
	Coil OFF contactor OFF	22~28mSEC
Rated Current		32A
Rated Using Current (Resistor Load (AC1)) 380-440V		32A
Main Circuit Surge Absorption Unit (Fuji Electric Co., Ltd.)		SZ-ZM1 (Radial Lead) or SZ-ZM2 (Axial Lead)
Coil Surge Absorb Unit (Fuji Electric Co., Ltd.)		SZ-Z4

Note: If the customer uses a contactor other than the one specified above, choose a contactor that is closest to the one specified above. Most importantly choose a contactor that has a coil resistance value higher than the one listed above.

Install the Main Circuit Surge Absorption Unit, and Coil Surge Absorption Unit (Chosen by the Customer) to the Contactor as illustrated below.



Make sure that the contactor can withstand the surge current as shown below.



5.9 Reserved Parameters

The following parameters are reserved.

Do not change any of them from the default setting.

Parameter Number	Lower Limit	Upper Limit	Default Setting
Pn002.3	0	2	0
Pn004	—	—	0000
Pn005	—	—	0001
Pn110.3	0	3	0
Pn119	1	2000	60
Pn11A	1	2000	1000
Pn11B	1	150	50
Pn11C	1	150	70
Pn11D	0	150	100
Pn11E	0	150	100
Pn11F	0	2000	0
Pn120	0	51200	0
Pn206	513	32768	16384
Pn511	—	—	8888

5.10 List of Upgraded Functions (Applicable only to SGDH amplifiers of version number 33□□□ or higher.)

5.10.1 Additional Functions

Additional Functions [Applicable Models]	Description	Reference Section
Direct-drive motor supporting function [SGDM/SGDH]	Applicable to direct-drive motors. (Servomotor Model: SGMCS-□□□)	1.1.2
Enhanced dividing output resolution [SGDM/SGDH]	The upper limit of dividing output 16384 [P/R] (equivalent to 16-bit) is increased to 262144 [P/R] (equivalent to 20-bit).	5.10.3
Reference pulse input multiplication range switching [SGDM/SGDH]	The reference pulse multiplication can be selected from 1 to 99. Use this function if the reference pulse frequency cannot be increased from the host controller. The setting cannot be changed during operation.	5.10.4
Second stage notch filter Changeable Q value [SGDM/SGDH]	Second stage notch filter is added so that two notch filters, first stage and second stage notch filters, can be set for two resonance generating points. The setting of parameter "Q-value" that determines the sharpness of notching can be changed to suppress the influence on the control loop and interaction between two notch filters.	6.1.6
Automatic Gain Switching [SGDM/SGDH]	The switching between Gain Setting 1 and Gain Setting 2 is automatically carried out according to the conditions of position reference and position error.	6.2.6

5.10.2 Improved Functions

Improved Functions	Description	Reference Section
Moment of inertia ratio setting range [SGDM/SGDH]	The setting range "0 to 10,000 %" of moment of inertia ratio (Pn103) is extended to "0 to 20,000 %."	5.11.1
Adaptation to single-turn data absolute encoders [SGDM/SGDH]	Adapted to single-turn data absolute encoders mounted on direct-drive motors	5.11.2
Improvement of linear motor related specifications [SGDH]	• The parameter Pn384 to set the maximum speed for linear motor is added. • Overload protection for self-cooling linear motors • Hole sensor monitoring function is added.	5.11.3

■ Speed Related Parameters When a Direct-drive Motor is Connected

As the maximum speed of SGMCS servomotor is approximately 1/10 of standard SGM□H servomotor, the unit of parameter setting is changed to 1/10 of the standard.
When a SGMCS servomotor is connected, the SERVOPACK changes the setting unit automatically as shown in the following table.
Also, when a motor with a maximum speed is 500 rpm or less is connected, the SERVOPACK changes the setting unit to 1/10 of the standard automatically.

Parameters No.	Name	Units		Setting Range	Factory Setting
		Direct Drive servomotor or servomotor whose maximum speed is 500 rpm or less	Others		
Pn301	Speed 1	0.1 rpm	rpm	0 to 10000	100
Pn302	Speed 2	0.1 rpm	rpm	0 to 10000	200
Pn303	Speed 3	0.1 rpm	rpm	0 to 10000	300
Pn304	JOG Speed	0.1 rpm	rpm	0 to 10000	500

Besides the parameter, the speed setting for the auxiliary function Fn003 "Zero-point search mode" is fixed to 6 [rpm] when a direct-drive servomotor is connected.
Also, the analog monitor output units are changed as shown in the shaded areas in the table below.

Parameter No.	Digit Place	Name	Setting	Contents	Factory Setting
Pn003	0 1	Analog Monitor 1 Analog Monitor 2	0	Motor speed: 1V/100 rpm	2 0
			1	Speed reference: 1V/100 rpm	
			2	Torque reference: 1V/100%	
			3	Position error: 0.05V/1 reference unit	
			4	Position error: 0.05V/100 reference units	
			5	Reference pulse frequency [converted to rpm]: 1V/100 rpm	
			6	Motor speed ×4: 1V/25 rpm	
			7	Motor speed ×8: 1V/12.5 rpm	
			8	Reserved parameters (Do not use.)	
			9		
			A		
			B		
			C		
			D		
			E		
			F		

5.10.3 Improvement of Dividing Output Resolution

The upper limit of conventional dividing pulse setting (Pn201) is 16384 [P/R] that is decided for 16-bit encoder. However, direct-drive servomotors are equipped with 20-bit encoder as standard. Therefore, the parameter Pn212 is added to adapt the dividing pulse setting for 20-bit encoder.
For the dividing pulse setting, either the existing Pn210 or the newly added Pn212 can be used.
Select Pn201 or Pn212 by the switch for parameters. The factory setting is Pn201.

- Dividing pulse is set in the resolution 16-bit or less, use Pn201.
- Dividing pulse is set in the resolution 17-bit or more, use Pn212.

For the setting method of dividing ratio for 17-bit or more resolution, refer to **[Setting PG dividing ratio of 5-digit or more]** on the next page.
The setting range of Pn212 differs depending on the encoder used.
The upper limit of dividing output frequency is 1.4 Mpps because of the restrictions on the hardware. Therefore, setting a high number of pulses limits the motor speed.
The table below shows the setting conditions when Pn212 is used.

Encoder Resolution (Bits)	Number of Encoder Pulses per Revolution (P/R)	Setting Range (P/R)	
13	2048	16 to 2048	Pn212 needs not be used.
16	16384	16 to 16384	
17	32768	16 to 32768	
20	262144	16 to 262144	

For settings higher than 16384 P/R, pulses must be set in the following increments.

PG Dividing Pulse Setting (P/R)	Increments (P/R)	Motor Speed Upper Limit (rpm)
16 to 16384	1-pulse	No limit (up to the motor maximum speed)
16386 to 32768	2-pulse	82×10^6/Set value
32772 to 65536	4-pulse	
65544 to 131072	8-pulse	
131088 to 262144	16-pulse	

The setting error alarm A.09 (dividing ratio setting error) will occur if the setting is outside the allowable range or does not satisfy the setting conditions. The overspeed alarm A.51 will occur if the motor speed exceeds the upper limit.
When setting the pulse dividing ratio using a digital operator or panel operator, the display of the number of pulses increments as shown in the above table and the upper limit will not increment above the resolution of mounted encoder.
When Pn212 is set without connecting a servomotor to the servo amplifier, the upper limit is automatically set to 2^{30} (=1073741824: the maximum output value of the sero amplifier) since the encoder resolution of the servomotor is unknown.
Therefore, it is recommended to set Pn212 after connecting a servomotor.

Related Parameters

Switches

Parameter No.	Digit Place	Name	Setting	Contents	Factory Setting
Pn207	2	Dividing Ratio Parameter Selection	0000	Use Pn201 (For 16-bit or less)	0
			0100	Use Pn212 (For 17-bit or more)	

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

Parameters

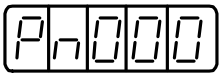
Parameter No.	Name	Unit	Setting Range	Factory Setting
Pn212	PG Dividing Pulse Setting	P/R	16 to 1073741824	2048

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

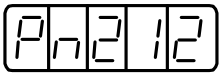
The following procedure describes how to set Pn212.

Setting a PG dividing ratio of 5-digit or more

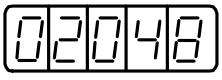
1. Press DSPL/SET Key to select the parameter setting mode.



2. Select the parameter Pn212.
   Press Left or Right Cursor Key to select the digit. The enabled digit blinks.
   Press Up or Down Cursor Key to change the value.

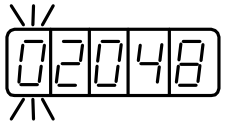


3. Press DATA/ENTER Key to display the lower 5 digits of the current PG dividing ratio setting value.



4. Press Left or Right Cursor Key to select the digit. The enable digit blinks.
   Press Up or Down Cursor Key to change the value.
   Pressing Left or Right Cursor Key when the left-end or right-end digit is blinking displays another 5 digits.

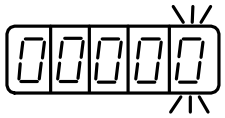
   Press Left Cursor Key when this digit blinks.



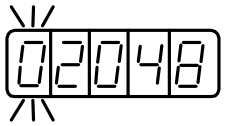
   The upper 5 digits are displayed.

5. Press Left or Right Cursor Key to select the digit. The enabled digit blinks.
   Press Up or Down Cursor Key to change the value.
   Pressing Left or Right Cursor Key when the left-end or right-end digit is blinking displays another 5 digits.

   Press Right Cursor Key when this digit blinks.



   The lower 5 digits are displayed.



   Repeat the steps 4 and 5 to change the data.

6. When the data is set, press DATA/ENTER Key.
   The set data blinks and will be saved.

   Note: When the password setting (write prohibited setting) is enabled, the setting can be read only by pressing Left or Right Cursor Key.

5.10.4 Reference Pulse Input Multiplication Range Switching Function

The position reference pulse input multiplication setting range can be switched between "×1" and "×1 to ×99."

Set Pn218.0 = 1 to enable this function, and set the multiplication in Pn217.

To change the reference pulse multiplication, the position reference pulse must be set to 0. Otherwise, the operation cannot be guaranteed.

This function is valid only for "reference pulse" and disabled for the reference pulse set from the option board in the configuration "SGDH servomotor and option board.î

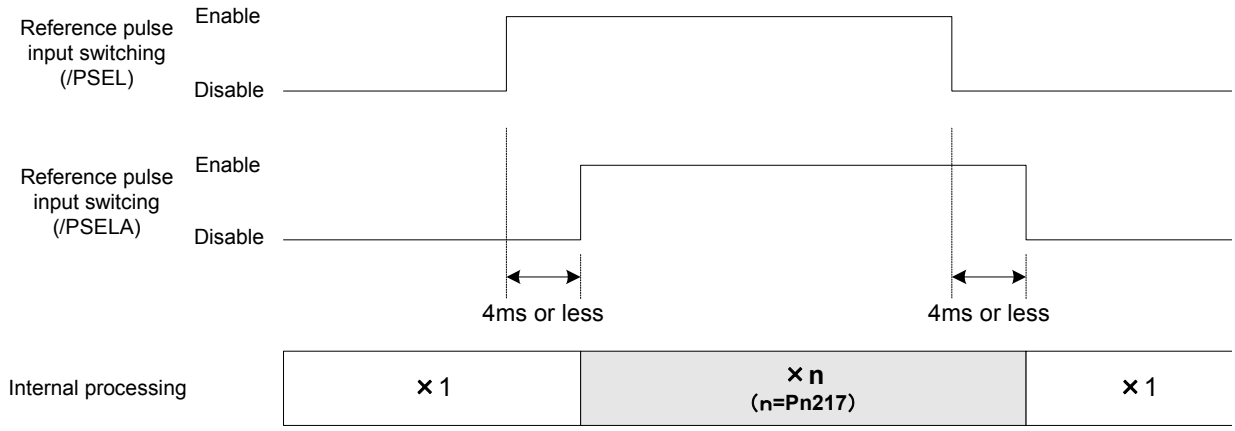


Fig.1 Timing Chart for Reference Pulse Input Multiplication Change

Related Parameters

Parameter

Parameter No.	Digit Place	Name	Setting	Contents	Factory Setting
Pn218	0	Reference pulse input multiplication range switching function	0	Disabled	0: Disabled
			1	Enabled	

Note: After changing the setting, turn OFF the control power supply and turn ON again to enable the new setting.

Parameter No.	Name	Unit	Setting Range	Factory Setting
Pn217	Reference Pulse Input Multiplication	×1	×1 to ×99	1

Note: The change of setting value is enabled in online mode.

Input Signal Selection*

Parameter No.	Digit Place	Name	Setting	Contents	Factory Setting
Pn513	0	/PSEL Signal Mapping (Reference Pulse Input Multiplication)	0	Inputs from the SI0 (CN1-40) input terminal.	8: Sets signal OFF
			1	Inputs from the SI1 (CN1-41) input terminal.	
			2	Inputs from the SI2 (CN1-42) input terminal.	
			3	Inputs from the SI3 (CN1-43) input terminal.	
			4	Inputs from the SI4 (CN1-44) input terminal.	
			5	Inputs from the SI5 (CN1-45) input terminal.	
			6	Inputs from the SI6 (CN1-46) input terminal.	
			7	Sets signal ON.	
			8	Sets signal OFF.	
			9	Inputs the reverse signal from the SI0 (CN1-40) input terminal.	
			A	Inputs the reverse signal from the SI1 (CN1-41) input terminal.	
			B	Inputs the reverse signal from the SI2 (CN1-42) input terminal.	
			C	Inputs the reverse signal from the SI3 (CN1-43) input terminal.	
			D	Inputs the reverse signal from the SI4 (CN1-44) input terminal.	
			E	Inputs the reverse signal from the SI5 (CN1-45) input terminal.	
			F	Inputs the reverse signal from the SI6 (CN1-46) input terminal.	

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

* Set Pn50A.0 to 1 so that inputs can be re-allocated.

Output Signal Selection

Parame-ter No.	Digit Place	Name	Set-ting	Contents	Factory Setting
Pn510	2	/PSELA Signal Mapping	0	Disabled	0: Disabled
			1	Outputs from the SO1 (CN1-25, 26) output terminal.	
			2	Outputs from the SO2 (CN1-27, 28) output terminal	
			3	Outputs from the SO3 (CN1-29, 30) output terminal.	

Note: After changing the setting, turn OFF the power and ON again to enable the new setting.

5.11 Improved Functions (Applicable only to SGDH amplifiers of version #33□□□ or higher.)

5.11.1 Moment of Inertia Ratio Setting Range

A load with moment of inertia ratio (Pn103) more than the existing maximum value 10,000% may be connected to a direct-drive motor. Accordingly, the upper limit of Pn103 is increased to 20,000%. (100% = 1:1)

5.11.2 Adaptation to Single-turn Data Absolute Encoder

A single-turn data absolute encoder is mounted to SGMCS servomotor as standard. The machine configuration with a SGMCS servomotor does not require harmonic gear, etc. so that the servomotor can be connected directly to a load. Therefore, for its absolute value detecting system, the load-end absolute value can be obtained by measuring only the angle of motor shaft.
In this case, the encoder multi-turn data is not required and no backup battery is required.
(With a single-turn data absolute encoder, the multi-turn data is always set to"0")

Single-turn data absolute encoder model	UTSB □ -B □□□□

Confirm the single-turn absolute encoder model in Motor Models Display (Fn011) on the digital operator or panel operator:

FN011-E. □□■■ (Encoder Model/Encoder Resolution Display)

□□ : Encoder model
- 00: Incremental encoder
- 01: Multiturn data absolute encoder
- 02: Single-turn data absolute encoder

■■ : Encoder Resolution
- 13: 13 bits
- 16: 16 bits
- 17: 17 bits
- 20: 20 bits

Specifications of Single-turn Data Absolute Encoder Model UTSB□-B□□□□

Item	Specifications
Battery for absolute encoder	Not required (Because no multiturn data needs to be stored.)
Fn008: Absolute encoder multi-turn reset function	Set to NO_OP and disabled
Fn013: Multiturn limit setting change when a multiturn limit disagreement alarm (A.CC) occurs	Set to NO_OP and disabled
Pn205: Multi-turn limit setting	Can be set, but the setting of Pn205 does not have any effect. The alarm A.CC does not occur when the setting is changed. And the multi-turn data is always "0" regardless of the Pn205 setting.
Pn002.2: Absolute encoder usage	Same as for the multi-turn absolute encoder Pn002.2=0: Use the absolute encoder as an absolute encoder Pn002.2=1: Use the absolute encoder as an incremental encoder
PAO serial data	The transmission format is the same as that of multi-turn absolute data However, the data section is always set to ì0î as follow. P+00000 [CR]
PSO serial data	The transmission format is the same as that of multi-turn absolute data However, the data section is always set to ì0î as follow. P+00000, nnnnnnn [CR] (n represents the absolute value within one rotation.)
Initial incremental pulse output time	The output pulse frequency is not changed. Therefore, the initial incremental pulse output time increases according to the number of bits of the mounted encoder. As the maximum resolution of the existing specification is 16 bits, the output time is 25 ms. With 20-bit encoder, the output time is 386 ms. The equation to obtain the output time by the number of bits of encoder is given below. The output time obtained by the equation is the minimum required time. $T = (2^n/170) \times (62.5/1000)$ [ms] T: Minimum time required to output initial incremental pulses n: Number of encoder bits Ex.) 16-bit encoder: $T = (65536/170) \times (62.5/1000) = 24.094 \rightarrow$ 25ms 20-bit encoder: $T = (1048576/170) \times (62.5/1000) = 385.506 \rightarrow$ 386ms

5.11.3 Improvement of Linear Motor Related Specifications

■ Additional Function: Parameter for Max. Speed for Linear Motors

The maximum speed can be set in the parameter.
This function can be used for the system where the servomotor speed does not reach its maximum. Decreasing the maximum speed in Pn384 can increase the resolution of speed control.

Related Parameter

Parameter No.	Name	Unit	Setting Range	Factory Setting
Pn384	Maximum speed for linear motors	100 mm/s	1 to 100	50

The setting of Pn384 must not be higher than the maximum speed of motor parameter.
If a speed higher than the maximum speed of motor parameter is set, the alarm A.55 "Maximum speed setting alarm" occurs.

To change the maximum speed in Pn384, set also the PG dividing ratio using the following functions.

Calculation of speed for linear motors and PG dividing ratio

The allowable maximum dividing ratio is calculated on the base of the set maximum motor speed, or the allowable maximum speed is calculated on the base of the set maximum dividing ratio.
The parameter whose setting is the base of calculation can be selected in the parameter Pn080 "Allowable maximum motor speed/dividing ratio calculation selection."
If a value higher than the maximum dividing ratio calculated on the base of the motor maximum speed is set, the alarm A.09 "Dividing ratio setting error" occurs.

Related Parameters

Parameter No.	Digit Place	Name	Setting	Description	Factory Setting
Pn080	3	Allowable maximum motor speed/dividing ratio calculation selection (The result of calculation is displayed in Un010.)	0	Fix the maximum motor speed, and calculate the allowable maximum dividing ratio.	0
			1	Fix the maximum dividing ratio, and calculate the allowable maximum motor speed.	

The result of calculation can be monitored by the monitoring function.

Parameter No.	Displayed Item	Unit	Remarks
Un010	Allowable maximum motor speed/ dividing ratio monitor	100 mm/s or Pulse/scale pitch（Pn280）	Displayed in decimal codes

■ Operation Procedure

Select the parameter Un010, and press DATA/ENTER Key.
The maximum motor speed or dividing ratio that can be set is displayed in the following order.

To fix the maximum motor speed and change the maximum dividing ratio (Pn080.3 = 0)

i S.****: Displays the maximum motor speed (Pn384). Press DSPL/SET Key to display the next line (ii).

ii P.****: Displays the maximum dividing ratio that can be set. Press DSPL/SET Key to return to the display of the line above (i).

To fix the maximum dividing ratio and change the maximum motor speed (Pn080.3 = 1)

i S.****: Displays the maximum motor speed that can be set. Press DSPL/SET Key to display the next line (ii).

ii P.****: Displays the maximum dividing ratio (Pn281). Press DSPL/SET Key to return to the display of the line above (i).

■ Overload Protection for Self-cooling Linear Motors

The linear motor has a self-cooling effect because of its moving coil. Therefore, the calculation of motor-side overload is modified, taking this cooling effect into account.

The equation is modified so that a square of thrust reference is reduced in proportion to the motion speed of linear motor's moving coil.
The factor of proportionality is calculated on the base of speed FB and the newly added parameter.
An alarm occurs under the following condition.

Overload level $<$ Σ **{(Thrust reference^2 × d) – Reference thrust^2}**

d is obtained by the following equation.

d = 1 – {(FB speed / Maximum speed) × (Parameter / 100)}

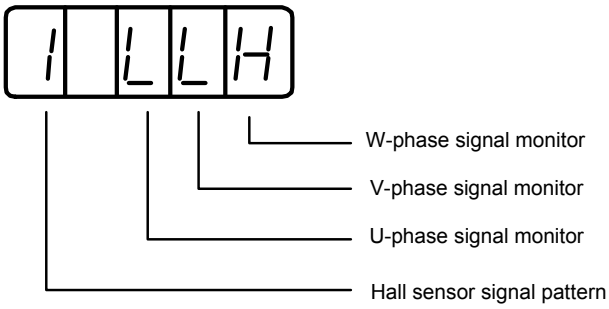
5.11.4 Supporting Function for Linear Motor with Hall Sensor

The hall sensor monitoring function is added for linear motors with a Hall sensor.

Parameter No.	Displayed Item	Unit	Remarks
Un011	Hall sensor signal monitor	–	–

■ Operation Procedure

Select the parameter Un011, and press DATA/ENTER Key. The Hall sensor signal is displayed as shown below.



Refer to the following table for the Hall sensor signal patterns.

Hall sensor signal pattern (UVW)	Signals		
	U-phase	V-phase	W-phase
0	L	L	L
1	L	L	h
2	L	h	L
3	L	h	h
4	h	L	L
5	h	L	h
6	h	h	L
7	h	h	h

The Hall sensors are set according to the motor phase order selection in parameter Pn080.1.
The processing at reading the Hall sensor signals has also been improved as follows.

If all the Hall sensor signals are 0 or 1 when the Hall sensors are connected, these signals are ignored.

- However, if it occurs two times consecutively, the alarm A.C2 occurs.
- If U-phase edge does not activate two times continuously, it is not recognized as U-phase edge.
- The angle for phase detection error is changed from 30 degrees to 40 degrees. (The error of angle at installation is added to the maximum error of the angle when the power is turned ON.)

6 Servo Adjustment

This chapter describes the functions required for servo adjustment. Find the required information by selecting the section from the following table of contents.

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6.1 Smooth Operation

This section provides technical information on the smooth operation of servomotors.

6.1.1 Using the Soft Start Function

The soft start function adjusts progressive speed reference input inside the servo amplifier so that acceleration and deceleration can be as constant as possible. To use this function, set the following parameters.

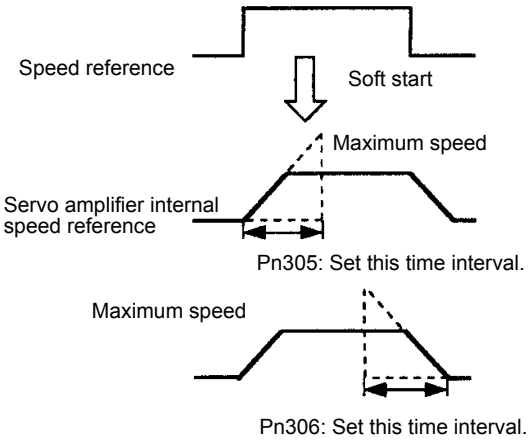
Parameter	Signal	Setting (ms)	Description
Pn305	Soft Start Acceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control
Pn306	Soft Start Deceleration Time	Setting Range: 0 to 10000 Default Setting: 0	Speed Control

In the servo amplifier, a speed reference is multiplied by the acceleration or deceleration value set in Pn305 or Pn306 to provide speed control.

The soft start function enables smooth speed control when progressive speed references are input or when contact input speed control is used. Set both Pn305 and Pn306 to "0" for normal speed control.

Set these parameters as follows:

- Pn305: The time interval from the time the motor starts until the maximum speed is reached.
- Pn306: The time interval from the time the motor is operating at the maximum speed until it stops.



6.1.2 Smoothing

The smoothing function applies a filter inside the servo amplifier to a constant-frequency reference input so that acceleration and deceleration can be as constant as possible. To use this function, set the following parameters.

Use the following parameter to set the type of filter to be applied.

Parameter	Signal	Setting	Description
Pn207.0	Position Reference Filter Selection	Default Setting: 0	Position Control

Either an acceleration/deceleration or average movement filter can be selected.

Pn207.0 Setting	Result
0	Enables acceleration/deceleration filter.
1	Enables average movement filter.

The time constant and time for these filters are set in the following parameters.

Time constant for Acceleration/Deceleration Filter:

Parameter	Signal	Setting (x0.01ms)	Description
Pn204	Position Reference Accel/Decel Time Constant	Setting Range: 0 to 6400 Default Setting: 0	Position Control

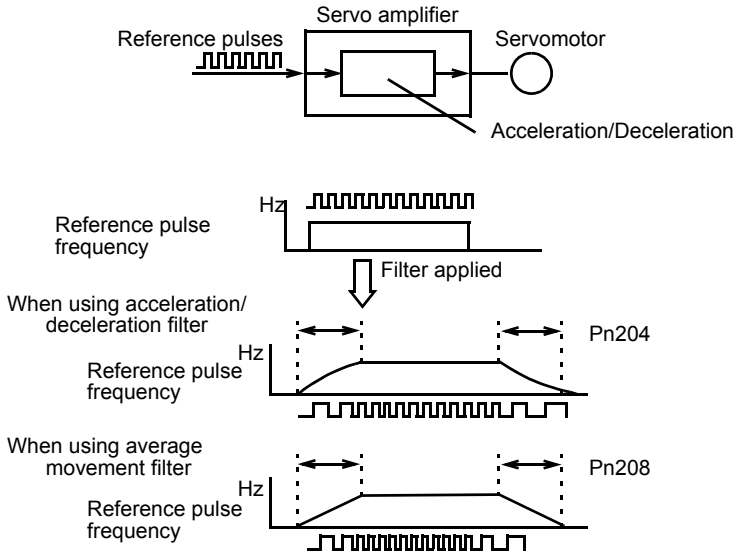
Averaging time for Average Movement Filter:

Parameter	Signal	Setting (x 0.01ms)	Description
Pn208	Position Reference Movement Averaging Time	Setting Range: 0 to 6400 Default Setting: 0	Position Control

This function provides smooth motor operating in the following cases:

- When the host device which outputs references cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., 10× or more).

This function does not affect the travel distance (i.e., the number of pulses).



6.1.3 Adjusting Gain

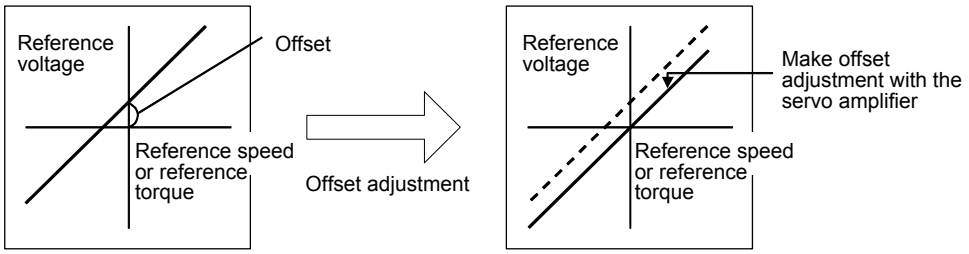
If speed loop gain or position loop gain exceeds the allowable limit for the servo system (including the machine to be controlled), the system will tend to vibrate or become too sensitive. Smooth operation is not possible under such conditions. Reduce each loop gain value to an appropriate value.

Refer to *6.2.1 Setting Servo Gain* for details regarding servo gain adjustment.

6.1.4 Adjusting Offset

The servo system does not operate smoothly if reference voltage from the host controller or external equipment has a reference offset value close to 0V. In that case, adjust the reference offset value to 0V.

■ Reference Voltage Offset from Host Controller or External Circuitry



■ Reference Offset Adjustment

The following two methods are provided to reset the reference offset value to 0V.

- Reference offset automatic adjustment
- Reference offset manual adjustment

If a position loop is formed in the host controller, be sure to make a manual offset adjustment and do not make automatic reference offset adjustment.

Refer to the following sections in *Chapter 7: Using the Digital Operator* for a detailed description of reference offset adjustment.

Adjustment Method	Detailed Description
Automatic	*7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset*
Manual	*7.2.4 Manual Adjustment of the Speed and Torque Reference Offset*

6.1.5 Setting the Torque Reference Filter Time Constant

If there is machine vibration which may be caused by the servodrive, try adjusting the filter time constant in Pn401. This may stop the vibration.

Parameter	Signal	Setting (x 0.01ms)	Application
Pn401	Torque Reference Filter Time Constant	Setting Range: 0 to 65535 Default Setting: 100	Speed/Torque Control, Position Control

The above constant is the filter time constant of the torque reference to be set in the servo amplifier. The smaller the value, the faster the speed control response will be. There is, however, a limit, depending on machine conditions.

6.1.6 Notch Filter

Vibration in the machine can sometimes be eliminated by using a notch filter for the frequency at which the vibration is occurring.

Parameter	Signal	Setting	Description
Pn408.0	Notch Filter Selection	Default Setting: 0	Speed/Torque Control, Position Control

This parameter can be set to enable the notch filter.

Pn408.0 Setting	Result
0	None.
1	Enables notch filter for torque reference.

Use the following parameter to set the frequency at which the filter is effective.

Parameter	Signal	Setting (Hz)	Description
Pn409	Notch Filter Frequency	Setting Range: 50 to 2000 Default Setting: 2000	Speed/Torque Control, Position Control

SGDH amplifiers with version number starting with 33□□□ or higher, have 2 notch filters (NF) incorporated in the torque control loop. These notch filters have both center frequency and Q value adjustments.
The notch filter may eliminate specific frequency vibration generated by resonance of a machine. The notch filter puts a notch in the gain curve at the specific vibration frequency. A higher notch filter Q value produces a sharper notch and phase delay.

The performances of first stage notch filter and newly added second stage notch filter are identical.
The filtering is executed in the following order.

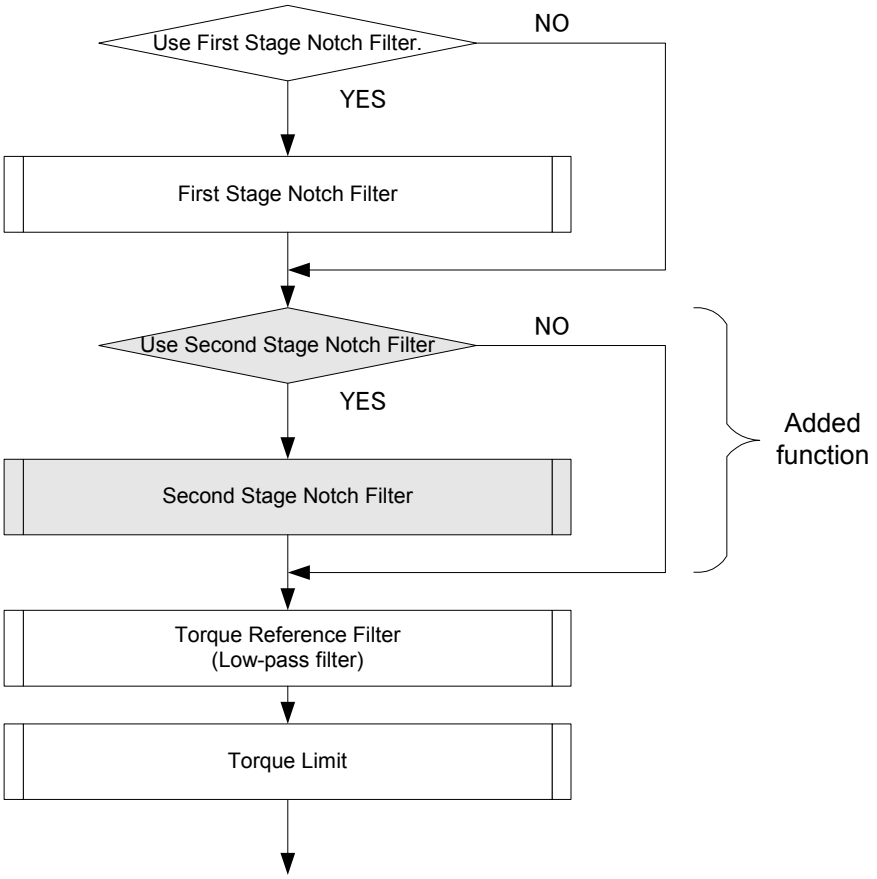
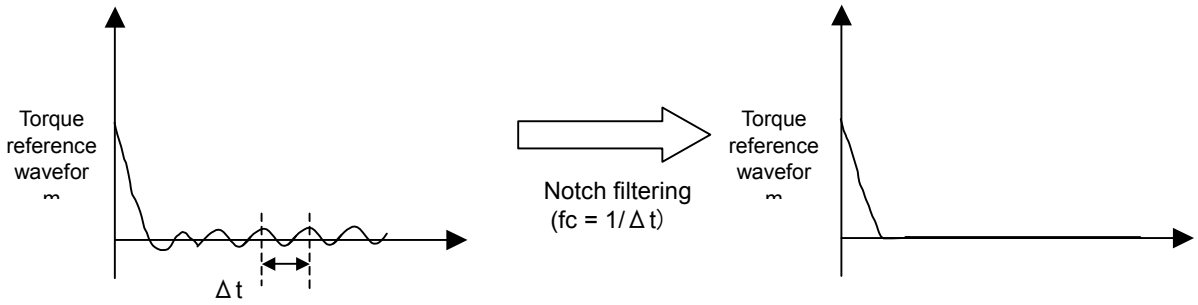


Fig.1 Torque Reference Filtering

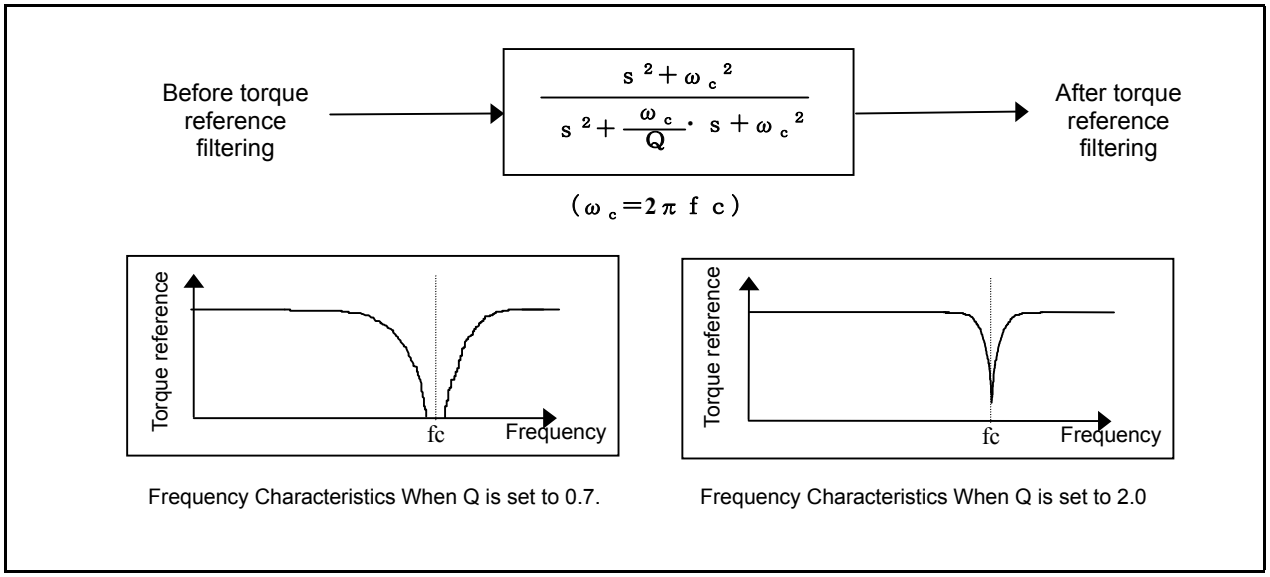
■ Notch Filter Function

The notch filter function decreases the response to the set frequency, and effective when there are machine vibrations. Adjusting the parameter setting according to the machine vibration frequency reduces the machine vibration.



■ Torque Reference Filtering and Frequency Characteristics

The torque reference filtering and frequency characteristics are shown in the following diagrams.



Frequency Characteristics When Q is set to 0.7.

Frequency Characteristics When Q is set to 2.0

Note: The frequency characteristics shown above indicate that no response of the speed proportional gain can be obtained if the difference between the speed proportional gain and the vibration frequency is too small.

Setting a smaller Q value decreases the response in wider zone around the set frequency.
Setting a bigger Q value decreases the response in the limited zone at about the set frequency.

When vibration is suppressed but overshoot occurs, increase the Q value may correct the overshoot.

Related Parameters

Switch

Parameter No.	Digit Place	Parameter Name	Setting	Description	Factory Setting
Pn408	0	Notch filter selection	0	Disabled	0
			1	Enabled	
	1	Fixed parameter	–	–	–
	2	Second stage notch filter selection	0	Disabled	0
			1	Enabled	
	3	Fixed parameter	–	–	–

Parameters

Parameter No.	Name	Unit	Setting Range	Factory Setting
Pn40A	Notch filter Q value	0.01	50 to 400	70
Pn40B	Second stage notch filter frequency	Hz	50 to 2000	2000
Pn40C	Second stage notch filter Q value	0.01	50 to 400	70

Caution

1. Exercise caution when setting the notch frequencies. Do not set the notch frequencies close to the speed loop's response frequency. Notch filter frequency should be at least 4 times higher than the speed loop's response frequency. Setting the notch frequency too close to the response frequency may cause vibration and damage the machine. The speed loop's response frequency is the speed loop gain (Pn100) when the inertia ratio (Pn103) is set to the correct value.
2. Change the notch filter frequency (Pn409 & Pn40B) only when the motor is stopped. Vibration may occur if the notch filter frequency is changed while the motor is rotating, causing damage to the machine.

6.2 High-Speed Positioning

This section provides technical information on high-speed positioning.

6.2.1 Setting Servo Gain

Use the servo gain setting function in the following cases.

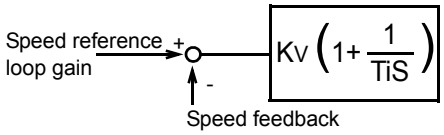
- To check each servo gain value that is automatically set after auto-tuning.
- To directly set each of the above servo gain values in another servo amplifier.
- To further refine responsiveness after auto-tuning (either to increase responsiveness or to reduce it).

■ Setting Speed Loop Gain

Set the following speed loop related parameters as required.

Parameter	Signal	Setting	Application
Pn100	Speed Loop Gain (K_v)	Setting Range: 1 to 2000Hz Default Setting: 40Hz	Speed Control, Position Control
Pn101	Speed Loop Integral Time Constant (T_i)	Setting Range: 15 to 51200 × 0.01ms Default Setting: 2000 × 0.01ms	Speed Control, Position Control

The higher the speed loop gain, or the smaller the speed loop integral time constant value, the faster the speed control response will be. There is, however, a certain limit depending on machine characteristics.



Speed loop gain K_V is adjusted in 1Hz increments provided that the following parameter is set correctly.

Parameter	Signal	Setting (%)	Application
Pn103	Inertia Ratio	Setting Range: 0 to 10000 Default Setting: 0	Speed/Torque Control, Position Control

$$\text{Inertia Ratio} = \frac{\text{Motor load inertia } (J_L)}{\text{Servomotor rotor inertia } (J_M)} \times 100\%$$

The load inertia of the servo amplifier reflected at the motor shaft is default set to the rotor inertia of the servomotor. Therefore, obtain the inertia ratio from the above formula and set parameter Pn103 properly.

The above parameters are automatically set by the auto-tuning operation.

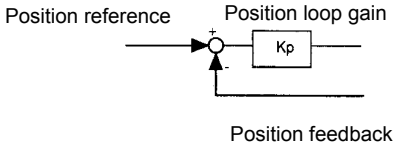
■ Setting Position Loop Gain

Set the following position loop-related parameter as required.

Parameter	Signal	Setting (s^{-1})	Application
Pn102	Position Loop Gain (K_P)	Setting Range: 0 to 2000 Default Setting: 0	Position Control

The above parameter is the position loop gain for the servo amplifier.

The higher the position loop gain, the smaller the position control error will be. There is, however, a certain limit depending on machine characteristics.

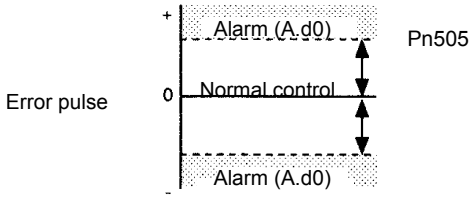


This gain setting is also valid for zero clamp operation.

The above parameter is automatically set by the auto-tuning operation.

Parameter	Signal	Setting (256 reference units)	Application
Pn505	Overflow Level	Setting Range: 1 to 32767 Default Setting: 1024	Position Control

Set in this parameter the error pulse level at which a position error pulse overflow alarm (A.d0) is detected.



If the machine permits only a small position loop gain value to be set in Pn102, an overflow alarm may arise during high speed operation. In this case, increase the value set in this parameter to avoid unnecessary alarms.

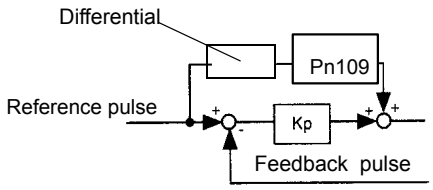
6.2.2 Using Feed-Forward Control

The time required for positioning can be shortened with feed-forward control by setting the following parameter.

Definition: **Feed-forward control** makes necessary corrections beforehand to prevent the control system from receiving the effects of external disturbance. By increasing the effective servo gain, feed-forward control improves the system's response.

Parameter	Signal	Setting (%)	Application
Pn109	Feed-forward	Setting Range: 0 to 100 Default Setting: 0	Position Control

Parameter Pn109 is set to apply feed-forward frequency compensation to position control inside the servo amplifier. Use it to shorten positioning time. Too high a value may cause machine vibration. For most applications, set Pn109 to 80% or less.



6.2.3 Using Proportional Control

If parameter Pn000.1 is set to 0 or 1 as shown below, input signal /P-CON serves as a PI/P control changeover switch.

- PI control: Proportional/integral control.
- P control: Proportional control.

Parameter	Signal	Setting (%)	Application
Pn000.1	Control Method Selection	Default Setting: 0	Speed Control, Position Control

<table>
<tr><th>Pn000.1 Setting</th><th colspan="3">Control Mode</th></tr>
<tr><td>0</td><td>Speed Control</td><td rowspan="2">Usual speed control or position control is selected.
Input signal /P-CON (CN1-41) is used to select PI control or P control.
<table><tr><td>CN1-41 is open.</td><td>PI control</td></tr><tr><td>CN1-41 is 0V</td><td>P control</td></tr></table></td><td rowspan="2">P or PI control selection
/P-CON
Servo amplifier
CN1-41</td></tr>
<tr><td>1</td><td>Position Control</td></tr>
</table>

■ Methods for Using Proportional Control

Proportional control can be used in the following two ways.

- When operation is performed by sending speed references from the host controller to the servo amplifier, the host controller can selectively use P control mode for particular conditions only. This method can suppress overshooting and shorten setting time. Refer to *6.2.5 Using Mode Switch* for particular conditions.
- If PI control mode is used when the speed reference has a reference offset, the motor may rotate at a very slow speed and fail to stop even if 0 is specified as a speed reference. In this case, use P control mode to stop the motor.

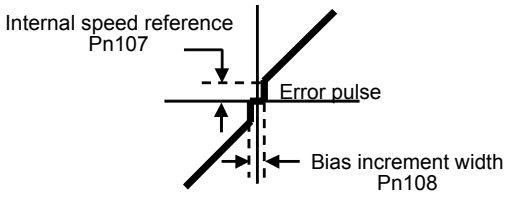
6.2.4 Setting Speed Bias

The settling time for positioning can be reduced by assigning bias to the speed reference block in the servo amplifier. To assign bias, use the following constants.

Parameter	Signal	Setting (rpm)	Application
Pn107	Bias	Setting Range: 0 to 450 Default Setting: 0	Position Control
Pn108	Bias Addition Width	Setting Range: 0 to 250 Default Setting: 7	Position Control

Set the parameters to shorten the time required for positioning according to the application.

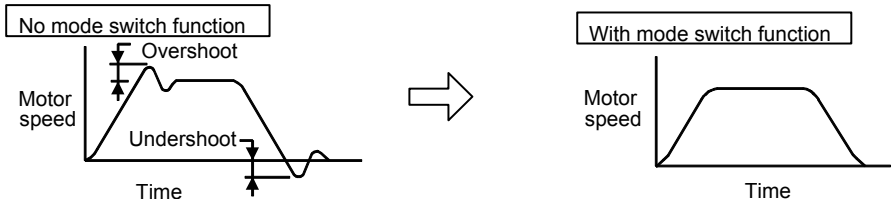
The bias increment width (Pn108) is expressed as an error pulse width that determines the time in which bias input (Pn107) takes effect. The bias input is ON if the error pulse width exceeds the value set in Pn108.



6.2.5 Using Mode Switch

Use the mode switch function for the following purposes.

- To suppress overshoot during acceleration or deceleration (for speed control).
- To suppress undershoot during positioning and to shorten the setting time (for position control).



The mode switch function makes it possible to automatically switch the servo amplifier's internal speed control mode from PI to P control mode and vice versa when specified conditions are satisfied.

Definition: PI control means proportional/integral control, and **P control** means proportional control. In effect, switching "from PI control to P control" reduces effective servo gain, thereby making the servo system more stable.

IMPORTANT

1. The mode switch is used to fully utilize performance of a servodrive to achieve very high-speed positioning. The speed response waveform must be observed to adjust the mode switch.
2. For normal use, the speed loop gain and position loop gain set by auto-tuning provide sufficient speed/position control. Even if overshoot or undershoot occurs, it can be suppressed by setting either:
   - The acceleration/deceleration time constant for the host device.
   - The soft start time constants (Pn305, Pn306)
   - The position reference acceleration/deceleration constant (Pn204) for the servo amplifier.

■ Selecting Mode Switch Setting

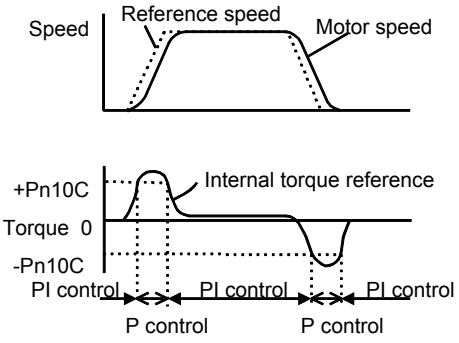
The servo amplifier incorporates four mode switch settings (0 to 3). Select a mode switch with the following parameter (Pn10B.0).

Pn10B.0 Setting	Description	Parameter Used to Set Detection Point	Setting Unit
0	Uses torque reference as the detection point. (Standard setting).	Pn10C	Percentage of rated torque (%)
1	Uses speed reference input as the detection point.	Pn10D	Motor Speed (rpm)
2	Uses acceleration as the detection point.	Pn10E	× 10rpm/s
3	Uses error pulse input as the detection point.	Pn10F	Reference unit
4	Mode Switch function is not used.	—	—

Torque Reference Input Used as Detection Point (Standard Setting)

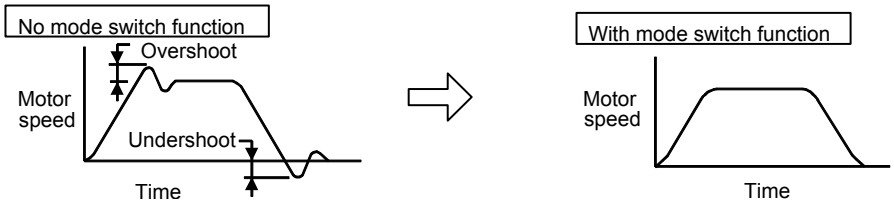
With this setting, if the value of torque reference input exceeds the torque set in parameter Pn10C, the speed loop switches to P control.

The servo amplifier is default set to this standard mode (Pn10C = 200).



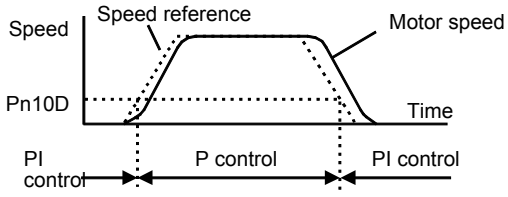
Operating Example

If the system is always in PI control without using the mode switch function, the speed of the motor may overshoot or undershoot due to torque saturation during motor acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates motor speed overshoot or undershoot.



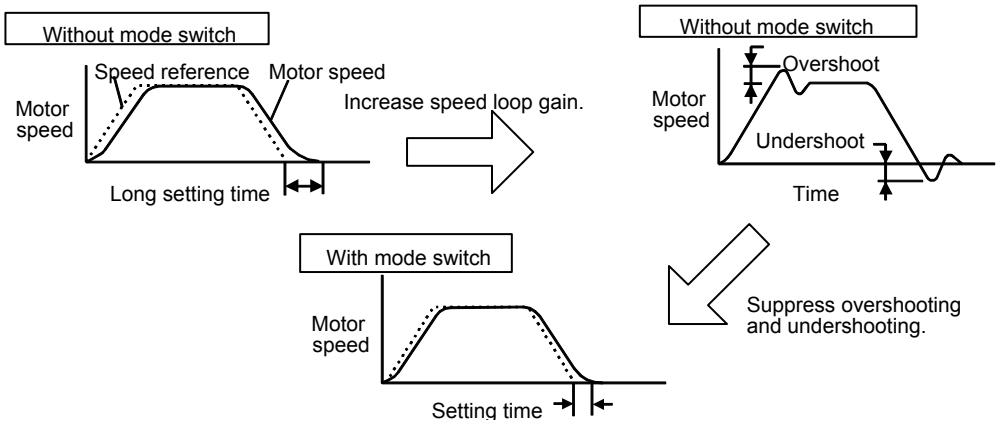
Speed Reference Used as Detection Point

With this setting, if a speed reference exceeds the value set in parameter Pn10D, the speed loop switches to P control.



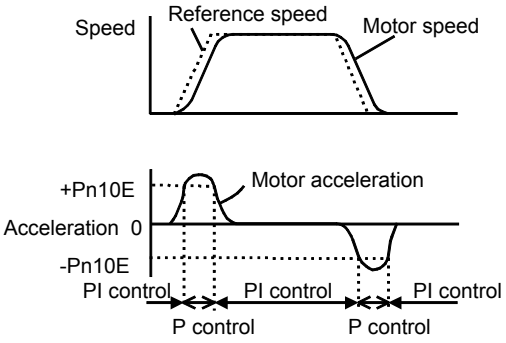
Operating Example

In this example, the mode switch is used to reduce setting time. Generally, speed loop gain must be increased to reduce setting time. Using the mode switch suppresses the occurrence of overshoot and undershoot as speed loop gain is increased.



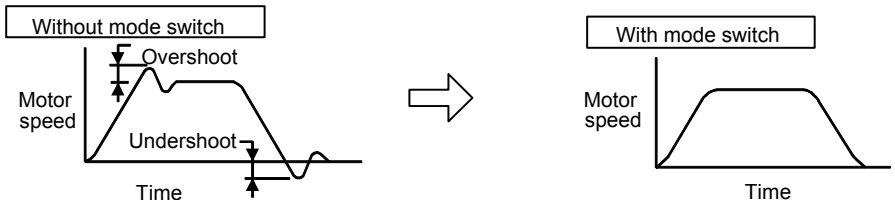
Acceleration Used as Detection Point

If motor acceleration exceeds the value set in parameter Pn10E, the speed loop switches to P control.



Operating Example

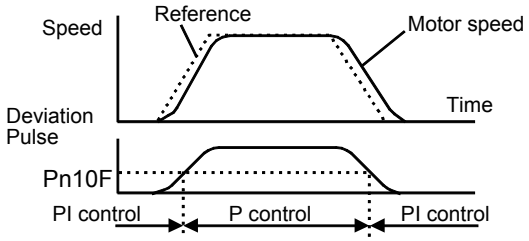
If the system is always in PI control without using the mode switch function, the speed of the motor may overshoot or undershoot due to torque saturation at the time of the acceleration or deceleration of the motor. The mode switch function suppresses torque saturation and eliminates motor speed overshoot or undershoot.



Error Pulse Used as a Detection Point

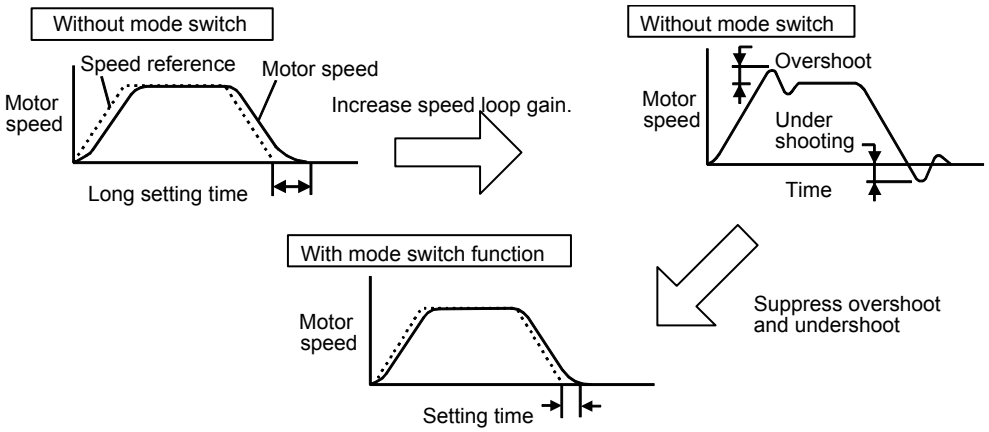
This setting is enabled for position control operation only.

If an error pulse exceeds the value set in parameter Pn10F, the speed loop switches to P control.



Operating Example

In this example, the mode switch is used to reduce setting time. Generally, speed loop gain must be increased to reduce setting time. Using the mode switch suppresses the occurrence of overshoot and undershoot when speed loop gain is increased.



6.2.6 Automatic Gain Switching Function (Applicable Only to SGDH amplifiers with version # 33□□□ or higher)

The automatic gain switching function switches the gain setting between the gain setting 1 and 2 according to the following conditions:

Whether position reference is specified or not, or
Position error level, or
AND logic of the above two conditions

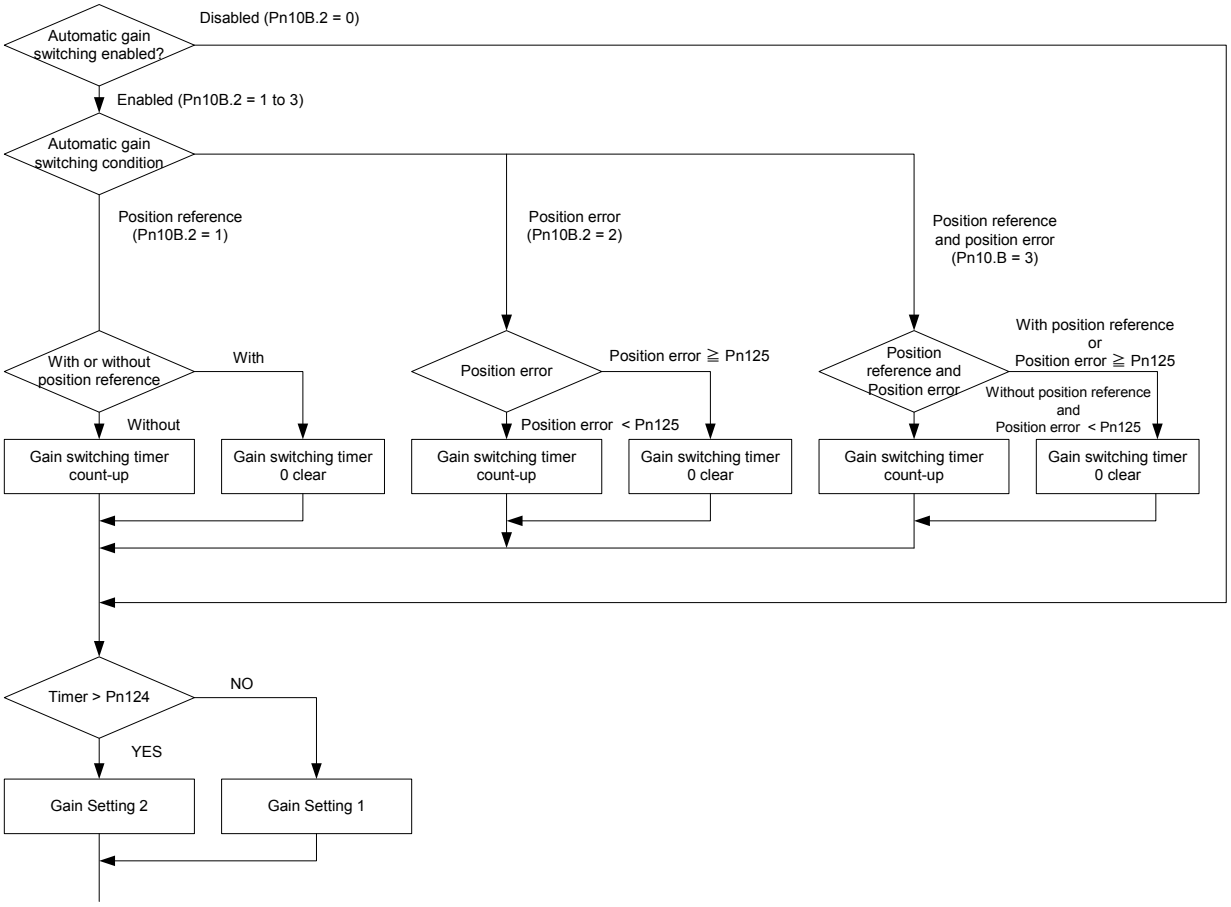
The position reference of the automatic gain switching condition indicates the reference pulses from CN1, the reference pulses from LD001 for SGDH Servo Amplifier + LD001, or the reference pulses from the option board for SGDH Servo Amplifier + option board.
Note that the automatic gain switching function is disabled for the control modes other than position control.
And, the real-time autotuning function is disabled while gain setting 2 is selected.

Gain Switching

Gain Setting 1	⇔	Gain Setting 2
Pn100: Speed loop gain		Pn104: Speed loop gain #2
Pn101: Speed loop integral time constant		Pn105：Speed loop integral time constant #2
Pn102: Position loop gain		Pn106：Position loop gain #2

The existing gain switching function by /G-SEL signal is also available. However, it cannot be used with the automatic gain switching function.
Note that automatic gain switching function is enabled only in position control mode. In the control modes other than position control, gain setting 1 is used.
When the automatic gain switching is enabled by setting 1 to 3 of Pn10B.2, the gain switching function by /G-SEL signal is disabled.

The following flowchart shows the automatic gain switching.



Related Parameters

Switch

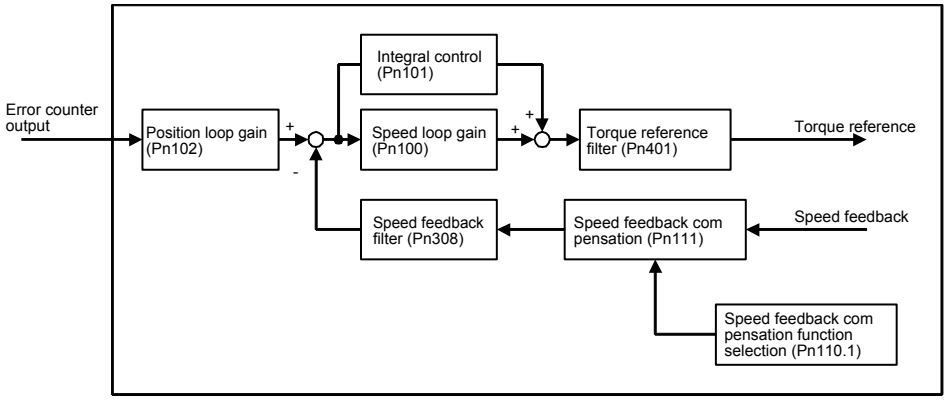
Parameter No.	Digit Place	Name	Setting	Description	Factory Setting
Pn10B	2	Automatic gain switching selection	0	Automatic gain switching disabled	0
			1	Position reference	
			2	Position error	
			3	Position reference and position error	

Parameters

Parameter No.	Name	Unit	Setting Range	Factory Setting
Pn124	Automatic gain switching timer	ms	1 to 10000	100
Pn125	Automatic gain switching width	Reference unit	1 to 250	7

6.2.7 Speed Feedback Compensation

Use this function to shorten the system's setting time in positioning operation.



Note: This function is available provided that the inertia ratio set in Pn103 is correct. Therefore, perform online auto-tuning to obtain and save the results as the parameters. Refer to *6.3 Auto-Tuning* for details. Otherwise, directly set the inertia ratio.

■ Adjustment Procedure

When adding the value of speed feedback compensation, be sure to follow the procedure described below and make servo gain adjustments while watching the analog monitor to observe the position error and torque reference. Refer to *6.5 Analog Monitor* for details.

1. Set parameter Pn110 to "0002" so that the online auto-tuning function will be disabled. Refer to *6.3.4 Parameters Related to Online Auto-Tuning* and *Appendix B List of Parameters* for details regarding Pn110.
2. First, make normal servo gain adjustments with no feedback compensation. In this case, gradually increase the speed loop gain in Pn100 while reducing the speed loop integral time constant Pn101, and finally set the speed loop gain in Pn100 to the same value as that of the position loop gain in Pn102.

The relationship between the speed loop gain and integral time constant is as follows:

Take the value obtained from the following formula as a reference value for setting the speed loop integral time constant in Pn101.

$$\text{Speed loop integral time constant} = \frac{4}{2\pi \times \text{Speed loop gain}} \text{ (s)}$$

Unit of speed loop gain: [Hz]

Check the unit when setting the speed loop integral time constant in Pn101. Pn101 is set in 0.01ms increments.

The units for speed loop gain (Hz) and position loop gain (s^{-1}) differ, nevertheless,

set these gains to the same numerical value.

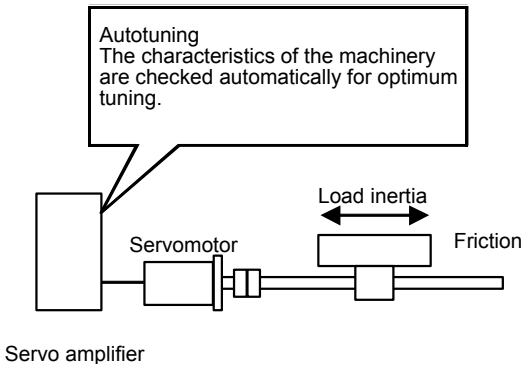
3. Repeat step 2 to increase the speed loop gain while watching the position error of the analog monitor to observe the setting time and the torque reference of the analog monitor to observe any occurrence of vibration. If there is any oscillating noise or noticeable vibration, gradually increase the time constant of the torque reference filter in Pn401.
4. Gradually increase only the position loop gain. When it has been increased about as far as possible, then decrease the speed feedback compensation in Pn111 from 100% to 90%. Then repeat steps 2 and 3.
5. Decrease the speed feedback compensation to a value lower than 90%. Then repeat steps 2 through 4 to shorten the setting time. If the speed feedback compensation is too low, however, the response waveform will vibrate.
6. Find the condition in which the shortest setting time is obtainable within the range where the position error or torque reference waveform observed through the analog monitor is not vibrating or unstable.
7. The servo gain adjustment is completed when no further shortening of the positioning time is possible.

IMPORTANT

- Speed feedback compensation usually makes it possible to increase the speed loop gain and position loop gain. The machinery may vibrate excessively if the compensation value greatly changes or Pn110.1 is set to "1" (i.e., speed feedback compensation disabled) after increasing the speed loop gain or position loop gain.

6.3 Auto-Tuning

If positioning is taking a long time, the speed loop gain or position loop gain of the servo system may not be set properly. If the gain settings are wrong, set them properly in accordance with the configuration and rigidity of the machinery.



The servo amplifier incorporates an online auto-tuning function, which checks the characteristics of the machinery automatically and makes the necessary servo gain adjustments. The function is easy to use and makes it possible for even beginners to perform servo gain tuning and set all servo gains as parameters.

The following parameters can be set automatically by using the online auto-tuning function.

Parameter	Description
Pn100	Speed loop gain
Pn101	Speed loop integral time constant
Pn102	Position loop gain
Pn401	Torque reference filter time constant

6.3.1 Online Auto-Tuning

Online auto-tuning is a control function which enables the servo amplifier to check changes in the load inertia during operation in order to maintain the target value for speed loop gain or position loop gain.

Online auto-tuning may not work well in the following cases.

- When the cycle for load inertia change is 200ms or shorter (when the load changes rapidly).
- When the application has slow acceleration or deceleration using the soft start function, and the speed error of the servomotor being driven is small.
- When adjusting the servomotor manually and operating at low gain (a machine rigidity of 1 or less).

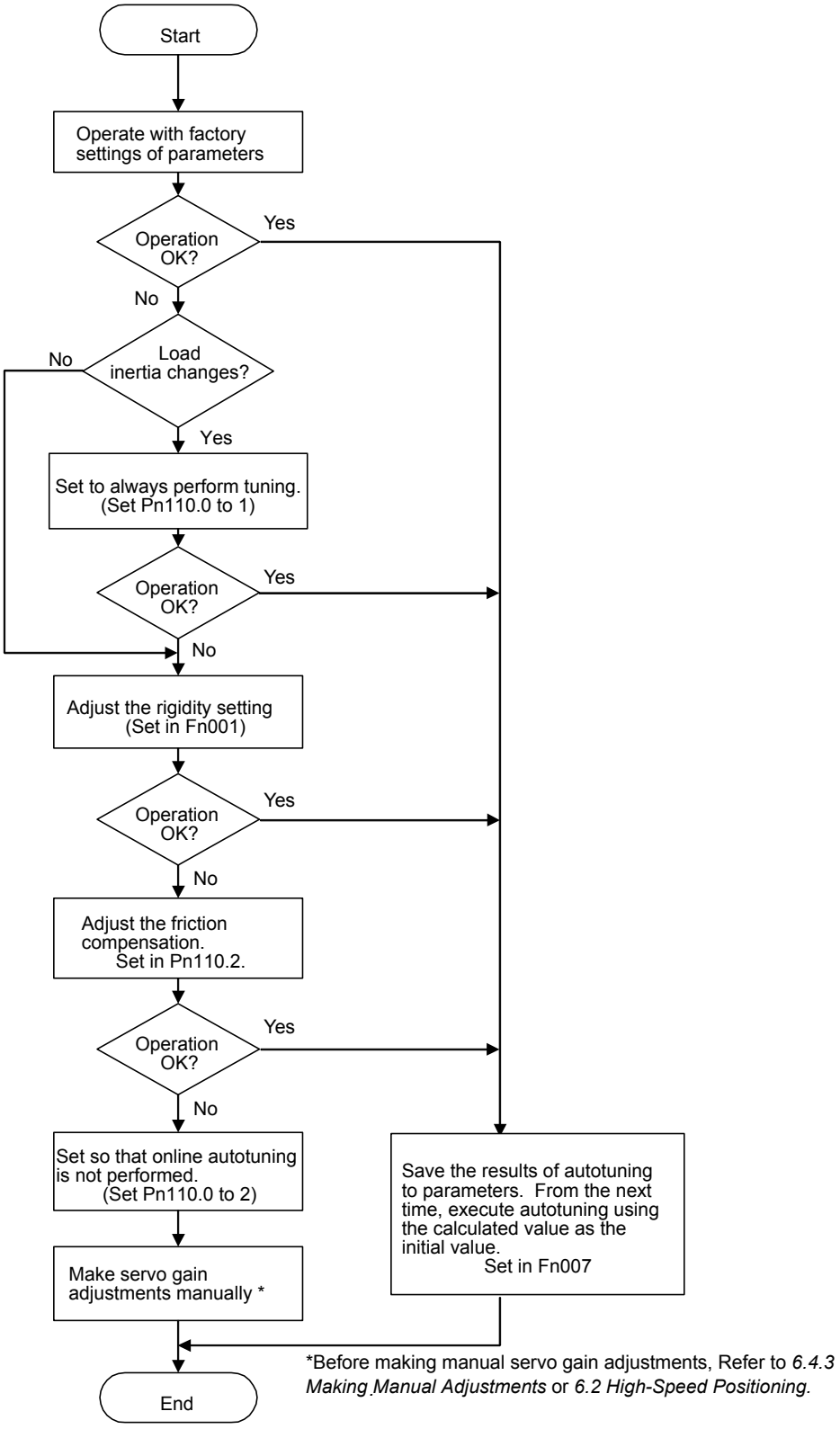
Disable the online auto-tuning function if tuning is not possible. (See *6.4.3 Making Manual Adjustments*).

IMPORTANT

- Do not use online auto-tuning in the following cases:
  - When using Torque Control Mode.
  - When using IP control (only when using parameter Pn10B.1 = 1) for the speed loop.
  - When using the torque feed–forward function.
  - When switching gain using /G–SEL.

■ Setting Parameters for Online Auto-Tuning

The following flowchart shows the procedure for setting the parameters for online auto-tuning.



*Before making manual servo gain adjustments, Refer to *6.4.3 Making Manual Adjustments* or *6.2 High-Speed Positioning.*

6.3.2 Mechanical Rigidity Settings for Online Auto-Tuning

For the mechanical rigidity settings at the time of online auto-tuning, select the target values for speed loop gain and position loop gain of the servo system. Any of the following ten levels of rigidity can be selected.

Fn001 Rigidity Setting	Position Loop Gain [s^{-1}]	Speed Loop Gain [Hz]	Speed Loop Integral Time Constant [0.01ms]	Torque Reference Filter Time Constant [0.01ms]
	Pn102	Pn100	Pn101	Pn401
1	15	15	6000	250
2	20	20	4500	200
3	30	30	3000	130
4	40	40	2000	100
5	60	60	1500	70
6	85	85	1000	50
7	120	120	800	30
8	160	160	600	20
9	200	200	500	15
10	250	250	400	10

Note: The Rigidity value is default set to 4.

As the rigidity value is increased, the servo system loop gain increases and the time required for positioning is shortened. If the rigidity is excessively high, however, it may cause the machinery to vibrate. In that case, decrease the set value.

The rigidity value setting automatically changes the parameters in the above table.

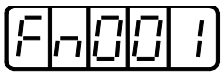
Note: If parameters Pn102, Pn100, Pn101, and Pn401 are set manually with the online auto-tuning function enabled, tuning is performed with the manually set values as target values.

■ Changing the Rigidity Setting

Use parameter Fn001 in the auxiliary function mode to change the rigidity setting. The procedure for changing the setting is as follows:

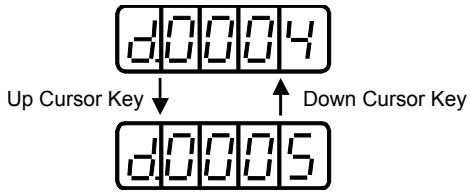
Using the Hand-held Digital Operator

1. Press the **MODE/SET** key and select Fn001 in the auxiliary function mode.

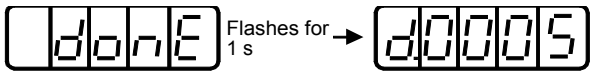


2. Press the **DATA/ENTER** key. The following data will be displayed.

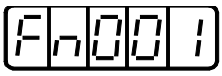
3. Press the **Up Arrow** ↑ or **Down Arrow** ↓ key to select the rigidity setting.



4. Press the **MODE/SET** key. The following display will flash for 1 second and then the rigidity setting will be changed.



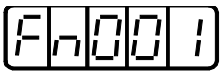
5. Press the **DATA/ENTER** key to return to the auxiliary function mode.



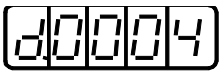
This completes the procedure for changing the rigidity setting.

Using the Built-in Panel Operator

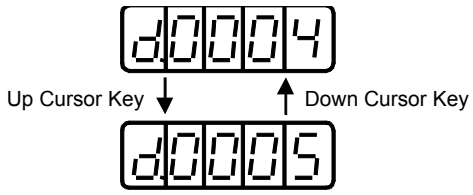
1. Press the **MODE/SET** key to select Fn007 in the auxiliary function mode.



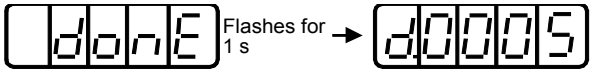
2. Press the **DATA/SHIFT** key for a minimum of 1 second. The following data will be displayed.



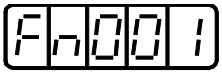
3. Press **Up Arrow** ↑ or **Down Arrow** ↓ key to select the rigidity setting.



4. Press the **MODE/SET** key. The following display will flash for 1 second and then the rigidity setting will be changed.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode.



This completes the procedure for changing the rigidity setting.

6.3.3 Saving Results of Online Auto-Tuning

Online auto-tuning always processes the latest load inertia to renew data so that the speed loop gain will reach the target value that has been set. When the servo amplifier is turned OFF, all the processed data is lost. Therefore, when the servo amplifier is turned ON again, online auto-tuning is performed by processing the factory-set values in the servo amplifier.

To save the results of online auto-tuning and use them as the initial values set in the servo amplifier when the servo amplifier is turned ON again, it is necessary to use constant Fn007 in the auxiliary function mode. In this case, the inertia value set in parameter Pn103 will be changed.

On the basis of the rotor inertia of the servomotor, the inertia ratio is expressed in percentage terms by the load inertia. The value set in Pn103 is used to calculate the load inertia at the time of online auto-tuning.

Parameter	Signal	Setting (%)	Description
Pn103	Inertia Ratio	Setting Range: 0 to 10000 Default Setting: 0	Speed/Torque Control, Position Control

$$\text{Inertia Ratio} = \frac{\text{Motor Load Inertia } (J_L)}{\text{Rotor Inertia } (J_M)} \times 100\%$$

The inertia ratio is default set to 0%.

IMPORTANT

- **Before making servo gain adjustments manually, be sure to set the inertia ratio in Pn103.**
  If the inertia ratio is incorrect, the speed loop gain (in 1Hz increments) set in Pn100 will be wrong.

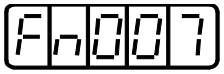
For details on setting Pn103, refer to *7.1.6 Operation in Parameter Setting Mode.*

■ Procedure for Saving Results of Online Auto-Tuning

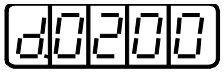
The procedure for saving the results of online auto-tuning is as follows:

Using the Hand-held Digital Operator

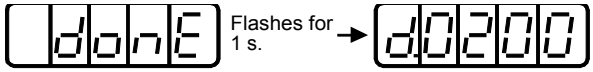
1. Press the **MODE/SET** key to select Fn007 in the auxiliary function mode.



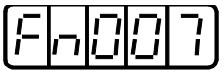
2. Press the **DATA/ENTER** key. If the inertia ratio is 200%, for example, the following data will be displayed.



3. Press the **MODE/SET** key. The following display will flash for 1 second and then the inertia ratio will be saved.



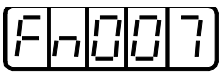
4. Press the **DATA/ENTER** key to return to the auxiliary function mode.



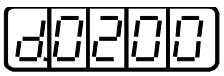
This completes the procedure for saving the results of online auto-tuning. When the servo amplifier is turned ON again, the inertia ratio set in Pn103 will be used as the default value.

Using the Built-in Panel Operator

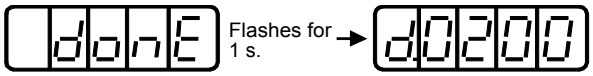
1. Press the **MODE/SET** key and select Fn007 in the auxiliary function mode.



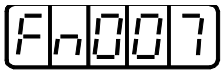
2. Press the **DATA/SHIFT** key for a minimum of 1 second. If the inertia ratio is 200%, for example, the following data will be displayed.



3. Press the **MODE/SET** key. The following display will flash for 1 second and then the inertia ratio will be saved.



4. Press the **DATA/SHIFT** key for a minimum of 1 second to return to the auxiliary function mode.



This completes the procedure for saving the results of online auto-tuning. When the servo amplifier is turned ON again, the inertia ratio set in Pn103 will be used as the default value.

6.3.4 Parameters Related to Online Auto-Tuning

This section provides information on a variety of parameters related to online auto-tuning.

■ Online Auto-Tuning Method

The following parameter is used to set the auto-tuning conditions.

Parameter	Signal	Setting (%)	Description
Pn110.0	Online Auto-Tuning Method	Default Setting: 0	Speed control, Position Control

Pn110.0 Setting	Result
0	Auto-Tuning is performed only when the system runs for the first time after the power is turned ON. After the load inertia is calculated, the calculated data is not refreshed.
1	Auto-Tuning is continuously performed (inertia value calculation).
2	The online auto-tuning function is not used.

This parameter is default set to "0". If the load inertia change is minimal or if the application makes few changes, there is no need to continue calculating the inertia while the system is in operation. Instead, continue to use the value that was calculated when the system was first started up.

Set this parameter to "1" if the load inertia always fluctuates due to the load conditions. Then the response characteristics can be kept stable by continuously refreshing the inertia calculation data is refreshed continuously and reflecting them in the servo gain.

If the load inertia fluctuation results within 200 ms, the inertia calculation data may not be refreshed properly. If that happens, set Pn110.0 to "0" or "2."

Set Pn110.0 to "2" if auto-tuning is not available or if the online auto-tuning function is not used because the load inertia is already known and the servo amplifier is manually adjusted by setting the inertia ratio data in Pn103.

■ Speed Feedback Compensation Selection

Use the following parameter to enable or disable speed feedback compensation.

Refer to *6.2.7 Speed Feedback Compensation.*

This parameter can be left as it is if online auto-tuning is performed. If this parameter is set manually, however, the setting is reflected to the operational setting made during online auto-tuning.

Parameter	Signal	Setting (%)	Description
Pn110.1	Speed Feedback Compensation Selection	Default Setting: 1	Speed control, Position Control

Pn110.1 Setting	Result
0	Speed Feedback Compensation enabled.
1	Speed Feedback Compensation disabled.

■ Friction Compensation Selection

Use the following parameter to enable or disable friction compensation to determine whether or not the friction of the servo system is to be taken into consideration for the calculation of load inertia.

If this compensation function is enabled, select small or large friction compensation according to the extent of friction in order to ensure highly precise load inertia calculation.

Parameter	Signal	Setting (%)	Description
Pn110.2	Friction Compensation Selection	Default Setting: 0	Speed control, Position Control

Pn110.2 Setting	Result
0	Friction Compensation enabled
1	Friction Compensation: Small
2	Friction Compensation: Large

Note: 1. Do not set friction compensation for loads with low friction (10% rated torque/speed or less).

2. Auto-Tuning will be performed as if the load inertia is 30 times the motor inertia.

6.4 Servo Gain Adjustments

This section describes information on the basic rules of gain adjustments in the servo amplifier, adjustment methods in a variety of cases, and reference set values.

6.4.1 Servo Gain Parameters

The following parameters must be set properly for servo gain adjustments.

- Pn100: Speed loop gain
- Pn101: Speed loop integral time constant
- Pn102: Position loop gain
- Pn401: Torque reference filter time constant

If the servo amplifier is used in the speed control mode with the analog voltage reference, the position loop is controlled by the host device. Therefore, position loop gain is adjusted through the host device.

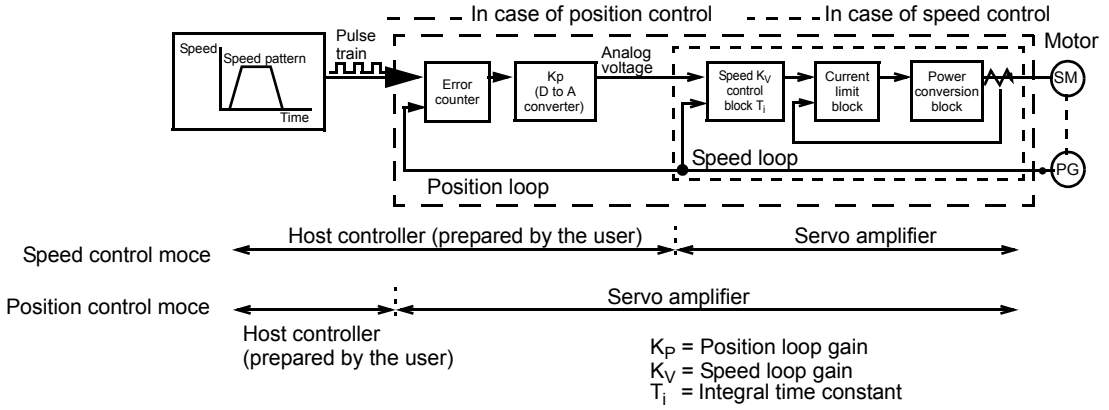
If the host is not available for adjustments of position loop gain, set the speed reference input gain in parameter Pn300. If the set value is improper, the servomotor may not run at top speed.

6.4.2 Basic Rules of Gain Adjustment

The servo system consists of three feedback loops (i.e., position loop, speed loop, and current loop). The innermost loop must have the highest response speed and the middle loop must have higher response speed than the outermost. If this principle is not followed, it will result in vibration or poor responsiveness.

The servo amplifier is designed to ensure that the current loop has good response performance. The user needs only to adjust the position loop and speed loop gain.

The servo system block diagram consists of the position, speed, and current loops, as shown below.



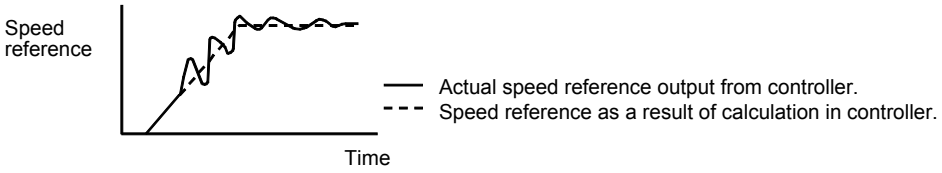
- Generally speaking, the responsiveness of the position loop cannot be higher than that of the speed loop. Therefore, to increase the position loop gain, you must

first increase the speed loop gain. If only the position loop gain is increased, oscillation will result in the speed reference and positioning time will increase, not decrease.

Position loop gain can be increased only to the point where oscillation begins in the mechanical system.

- If the position loop response is faster than the speed loop response, speed reference output from the position loop cannot follow the position loop response due to the slower speed loop response. Therefore, the position loop will keep accumulating errors, thus increasing the amount of speed reference output.

  As a result, the motor speed will be excessive and the position loop will try to decrease the amount of speed reference output. The speed loop responsiveness degrades, and the motor will not be able to follow. The speed reference will oscillate as shown in the following graph. If this happens, reduce the position loop gain or increase the speed loop gain.


Speed reference
Actual speed reference output from controller.
Speed reference as a result of calculation in controller.
Time

- The position loop gain must not exceed the natural frequency of the mechanical system. For example, if the mechanical system is an articulated robot, the rigidity of the machinery mechanism is very low because the mechanism incorporates a harmonic gear reducer and the natural frequency of the mechanical system is 10 to 20Hz. In this case, the position loop gain can be set to 10 to 20(s^{-1}).

  If the mechanical system is a chip mounting machine, IC bonding machine, or high-precision machining tool, the natural frequency of the system is 70Hz or more. Therefore, the position loop gain can be set to 70(s^{-1}) or higher.

  When high responsiveness is required, it is not only important to ensure the responsiveness of the servo system (the controller, servo amplifier, motor, and encoder), but it is also necessary to ensure that the mechanical system have high rigidity.

6.4.3 Making Manual Adjustments

The auto-tuning function uses a gain adjustment algorithm with a comparatively large safety margin by considering a variety of mechanical systems to which the servo amplifier is applied. Therefore, the servo amplifier may not satisfy the response characteristics of some applications. The auto-tuning function is not available to machines with low rigidity or high fluctuation.

In such cases, observe the mechanical systems and make manual adjustments of parameters.

■ Speed Control

Required Parameters

The following parameters are used.

- Speed Loop Gain (Pn100)

  This parameter is used for determining the responsiveness of the speed loop. For the best response, set this parameter as high as possible, without exceeding the point where the mechanical system vibrates. The value of speed loop gain is the same as the set value of Pn100 if the inertia ratio set in Pn103 is correct.

  Speed loop gain Kv = Set value of Pn100 (Hz)

  Set Pn103 to the following value.

$$\text{Pn103 Setting Value} = \frac{\text{Motor load inertia } (J_L)}{\text{Servomotor rotor inertia } (J_M)} \times 100\%$$

Note: In the case of manual adjustments of parameters, the user must set the value of parameter Pn103. The inertia ratio can be obtained if the servo gain constant is written with parameter Fn007 after auto-tuning has been performed. For details regarding Fn007, refer to *6.3 Auto-Tuning*.

- Speed Loop Integral Time Constant (Pn101)

  The speed loop has an integral element so that the speed loop can respond to minute inputs. This integral element delays the operation of the servo system, resulting in a longer positioning settling time. As the value of the time constant increases, the response becomes slower. If the load inertia is large or the mechanical system is likely to vibrate, make sure that the speed loop integral time constant is large enough. Use the following formula to calculate the optimum integral time constant.

$$T_i \geq 2.3 \times \frac{1}{2\pi \times K_v}$$

Where: T_i = Integral time constant [s]
K_v = Speed loop gain (calculated from the above) [Hz]

- Torque Reference Filter Time Constant (Pn401)

  If the mechanical system uses ball screws, torsional resonance may result. In this case, the oscillation noise will be a high-pitched tone. The oscillation may be minimized by increasing the time constant of the torque reference filter. Like the integral time constant, this filter causes a delay in the operation of the servo system. Therefore, this constant must not be set to an excessively large value.

- Speed Reference Input Gain (Pn300)

  Changing the speed reference input gain set in Pn300 is equivalent to changing the position loop gain. In other words, an increase in the speed reference input gain set in Pn300 is equivalent to a decrease in the position loop gain and vice versa. Use this parameter in the following cases.

  - When the host controller does not have a function for adjusting the position loop gain. (The host incorporates a D/A converter to change the number of bits but cannot make fine adjustments of position loop gain.)
  - When it is necessary to clamp the full range of the speed reference output of the host device to a specified rotation speed.

In normal operation, the default setting can be used as is.

Note: If the servo amplifier is used for speed control, the position loop gain set in Pn102 is enabled in zero–clamp mode only. In normal control operation, change the position loop gain through the host or change the speed reference input gain in Pn300 in the servo amplifier. The position loop gain remains the same if the setting in Pn102 is changed.

Adjustment Method

1. Set the position loop gain to a low value in the host controller. Then increase the speed loop gain set in Pn100 to within a range where there is no noise or oscillation. If the position loop gain cannot be changed through the host controller, increase the speed reference input gain set in Pn300 to a larger value.
2. Decrease the speed loop gain a little from the value set in step 1. Then increase the position loop gain through the host controller to a range where there is no noise or oscillation. Decrease the set value of Pn300 even if the position loop gain cannot be changed through the host controller.
3. Set the speed loop integral time constant in Pn101 while observing the positioning settling time and the vibration of the mechanical system. If the constant is too large, positioning settling time will be long.
4. Set the torque reference filter to a small value in Pn401 if the mechanical system has no apparent shaft torsional resonance. If the mechanical system generates oscillation noise in a high-pitched tone, shaft torsional resonance may be occurring. In that case, set Pn401 to a larger value.
5. Finally, progressively make fine adjustments to parameters such as the position loop gain, speed loop gain, and integral time constant to find the optimal point.

■ Position Control

Parameters

The following parameters are used.

- Speed Loop Gain (Pn100)

  This parameter is used for determining the response speed of the speed loop. For the best response, set this parameter as high as possible, without exceeding the point where the mechanical system vibrates. The value of speed loop gain is the same as the set value of Pn100 if the inertia ratio set in Pn103 is correct.

  Speed loop gain Kv = Set value of Pn100 (Hz)

  Set Pn103 to the following value:

$$\text{Pn103 Setting Value} = \frac{\text{Motor shaft reflected load inertia } (J_L)}{\text{Servomotor rotor inertia } (J_M)} \times 100\%$$

Note: In the case of manual adjustments of parameters, the user must set the value of parameter Pn103. The inertia ratio can be obtained if the servo gain constant is written with parameter Fn007 after auto-tuning has been performed. For details regarding Fn007, refer to *6.3 Auto-Tuning*.

- Speed Loop Integral Time Constant (Pn101)

  The speed loop has an integral element so that the speed loop can respond to minute inputs. This integral element delays the operation of the servo system, resulting in longer positioning settling time. As the value of the time constant increases, the response becomes slower.

  If the load inertia is large or the mechanical system is likely to vibrate, make sure that the speed loop integral time constant is large enough. Use the following formula to calculate the optimum time constant.

$$T_i \geq 2.3 \times \frac{1}{2\pi \times K_v}$$

  Where: T_i = Integral time constant [s]
  K_v = Speed loop gain (calculated from the above) [Hz]

- Torque Reference Filter Time Constant (Pn401)

  If the mechanical system uses ball screws, torsional resonance may result. In this case, the oscillation noise will be a high-pitched tone. The oscillation may be minimized by increasing the time constant of the torque reference filter. Like the integral time constant, this filter causes a delay in the operation of the servo system. Therefore, this constant must not be set to an excessively large value.

- Position Loop Gain (Pn102)

  The responsiveness of the servo system is determined by the position loop gain. The response increases if the position loop gain is set to a high value, and the time required for positioning will be shortened. In order to set the position loop gain to a high value, the rigidity and natural frequency of the mechanical system

must be high.

The responsiveness of the whole servo system may become unstable if only the position loop gain is increased. Because the speed reference, as output from the position loop, is likely to become unstable. Increase the speed loop gain while observing the response.

Adjustment Method

1. Set the position loop gain to a comparatively low value. Then increase the speed loop gain set in Pn100 to within a range where there is no noise or oscillation.
2. Decrease the speed loop gain a little from the value set in step 1. Then increase the position loop gain to within a range where there is no overshooting or oscillation.
3. Set the speed loop integral time constant in Pn101 while observing the positioning settling time and the vibration of the mechanical system. If the constant is too large, the positioning settling time will be too long.
4. Set the torque reference filter to a small value in Pn401 if the mechanical system has shaft torsional resonance. If the mechanical system generates oscillation noise in a high-pitched tone, shaft torsional resonance may occur. In that case, set Pn401 to a larger value.
5. Finally, progressively make fine adjustments to parameters such as the position loop gain, speed loop gain, and integral time constant to find the optimal points.

■ Function to Improve Response Characteristics

The mode switch, feed-forward, and bias functions can improve the response of the servo system only if they are used properly. If they are used improperly, they will worsen the response. Refer to the following instructions and make adjustments to these functions while observing the change in the actual response.

Mode Switch

Use the mode switch function to improve the transient characteristics of the servo system if there is torque reference saturation at the time of acceleration or deceleration. The speed loop in PI (proportional and integral) control is switched over to P (proportional) control when the operation speed exceeds the set value in this function.

Feed-forward Function

The responsiveness is increased by using the feed-forward function. This function is not effective if the position loop gain is set to a high value. Adjust the feed-forward set value of Pn109 as described below.

1. Adjust speed and position loops according to the method described on this page.

2. Gradually increase the set value of Pn109 so that the positioning completion signal (/COIN) will be output too quickly.

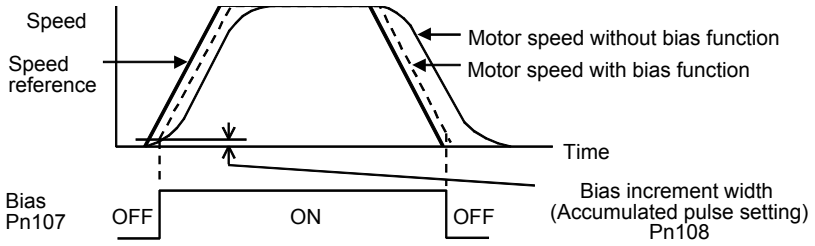
Make sure that the positioning completion signal (/COIN) does not bounce (i.e., turned ON and OFF repeatedly within a short period) and that speed overshoot does not occur. These will likely occur if the feed-forward value is too high.

It is possible to add a primary delay filter (to be set in Pn10A) to the feed-forward function. The primary delay filter may prevent the positioning completion signal from bouncing and the system speed from overshooting.

Bias Function

This function adds the bias set in Pn107 to the output (i.e., speed reference) of the error counter if the number of accumulated pulses of the error counter exceeds the bias increment width set in Pn108. The bias will not be added if the output is within the bias increment width. As a result, the number of accumulated pulses of the error counter decreases and the time required for positioning can be shortened.

If the bias set value of Pn107 is too large, the motor speed will be unstable. The optimum bias value varies with the load, gain, and bias increment width. Make bias adjustments while observing the response. When not using this function, set Pn107 to 0.



6.4.4 Gain Setting Reference Values

This section describes servo gain reference values.

Refer to the following for optimal gain adjustments according to the rigidity of the mechanical system. Refer to these values and use the previously mentioned methods to make gain adjustments. These values are for reference only and do not mean that the mechanical system has good response characteristics or is free from oscillation in the specified ranges.

Observe the response by monitoring the response waveform and make the optimum gain adjustments. If the rigidity of the machinery is high, gain increments exceeding the described ranges are possible.

■ Machines with High Rigidity

These machines are directly connected to ball screws.

Examples: Chip mounting machine, bonding machine, and high-precision machine tool

Position Loop Gain (Pn102)	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)
50 to 70s^{-1}	50 to 70Hz	5 to 20ms

■ Machines with Medium Rigidity

These machines are driven by ball screws through speed reducers or long-length machines directly driven by screws.

Examples: General machine tool, transverse robot, and conveyor

Position Loop Gain (Pn102)	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)
30 to 50s^{-1}	30 to 50Hz	10 to 40ms

■ Machines with Low Rigidity

These machines are driven by timing belts, chains, or machines with harmonic gear reducers.

Examples: Conveyor, and articulated robot

Position Loop Gain (Pn102)	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)
10 to 20s^{-1}	10 to 20Hz	50 to 120ms

IMPORTANT

- When the inertia ratio is larger than 10, start gain adjustments with the position and speed loop gains slightly below the ranges given above and the speed loop integral constant slightly over the range.
- When the inertia ratio is much larger, start the gain adjustments with the position and speed loop gains set to the smallest values and the speed loop integral constant to the large value in the ranges given above.

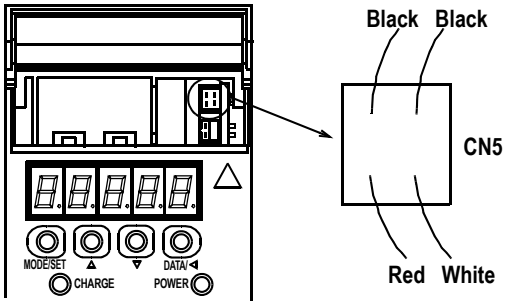
In speed control operation, the position loop gain is set through the host controller. If that is not possible, adjust the position loop gain with the speed reference input gain in Pn300 in the servo amplifier. In speed control operation, the position loop gain set in Pn102 is enabled in zero-clamp mode only. Position loop gain K_p is obtainable from the following formula.

$$K_p \geq \frac{V_s}{\varepsilon}$$

Where: K_p (s^{-1}) = Position Loop Gain
V_s (pps) = Constant Speed Reference
ε (Pulse) = Constant Error: The number of accumulated pulses of the error counter at the above constant speed.

6.5 Analog Monitor

The analog monitor can be used to observe a variety of analog voltage signals. Analog monitor signals must be observed through the CN5 connector using the DE9404559 cable.



Cable Color	Signal Name	Description
White	Analog monitor 1	Torque reference: 1V/100% rated torque
Red	Analog monitor 2	motor speed:1 V/1000rpm
Black (two wires)	GND (0V)	—

Analog monitor signals can be selected with parameters Pn003.0 and Pn003.1.

Parameter	Signal	Setting	Description
Pn003.0	Analog Monitor 1	Default Setting: 2	Speed/Torque Control, Position Control
Pn003.1	Analog Monitor 2	Default Setting: 0	Speed/Torque Control, Position Control

The following monitor signals can be observed.

Settings in Pn003.0 and Pn003.1	Description	
	Monitor signal	Observation gain
0	Motor speed	1V/1000rpm
1	Speed reference	1V/1000rpm
2	Torque reference	1V/100% rated torque
3	Position error	0.05 V/1 reference unit
4	Position error	0.05 V/100 reference unit
5	Reference pulse frequency (converted to rpm)	1V/1000rpm
6	Motor speed	1V/250rpm
7	Motor speed	1V/125rpm
8 - E	Reserved monitor signal	—

Note: 1. In the case of torque or speed control mode, the position error monitor signal has no meaning.

2. The output voltage range of the analog monitor is ±8V maximum. The polarity of the output voltage will be changed if ±8V is exceeded.

7 Using the Digital Operator

This chapter describes the basic operation of the digital operator and the features it offers. All parameter settings and motor operations can be executed by simple, convenient operations. Operate the digital operator as you read through this chapter.

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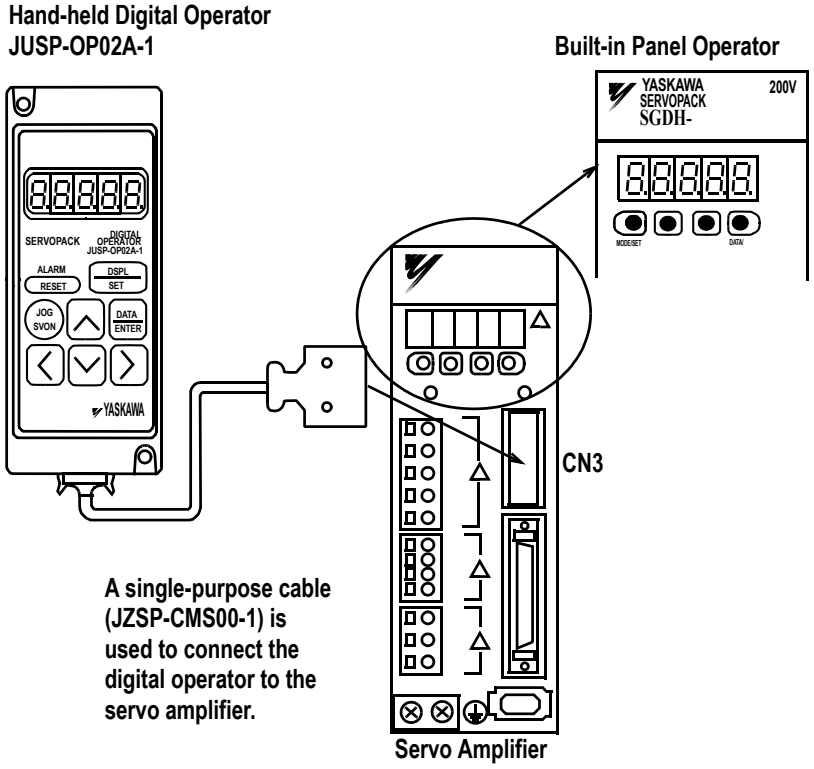
7.1 Basic Operation

This section provides information on the basic operation of the digital operator for setting operating conditions.

7.1.1 Connecting the Digital Operator

There are two types of digital operators. One is a built-in operator incorporating a panel indicator and switches located on the front panel of the servo amplifier. This type of digital operator is also called a panel operator. The other one is a hand-held operator (i.e., the JUSP-OP02A-1 digital operator), which can be connected to the servo amplifier through connector CN3 of the servo amplifier.

There is no need to turn OFF the servo amplifier to connect this hand-held operator to the servo amplifier. Refer to the following illustrations to connect the hand-held digital operator to the servo amplifier.

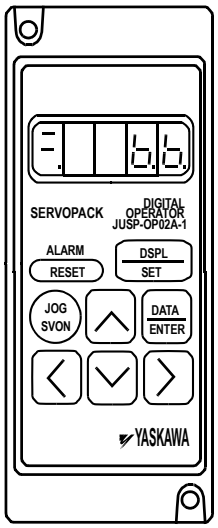


Note: If the hand-held digital operator is connected to the servo amplifier, the built-in panel operator does not display anything.

7.1.2 Functions

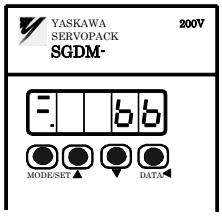
The digital operator can be used for parameter settings, operating references, and status displays.

This section provides information on the keys and their functions available from the initial displays.



Key	Name		Function
ALARM RESET	**RESET** Key		Press this key to reset the servo alarm
DSPL SET	**DSPL/SET** Key		• Press this key to select the status display mode, auxiliary function mode, parameter setting mode, or monitor mode. • This key is used for data selection in parameter setting mode
DATA ENTER	**DATA/ENTER** Key		Press this key to set each parameter or display the set value of each parameter.
^	Value Change/ JOG Key	**Up Arrow** Key	Press this key to increase the set value. This key is used as a forward start key in JOG operation.
v		**Down Arrow** Key	Press this key to decrease the set value. This key is used as a reverse start key in JOG operation.
>	Digit Select Key	**Right Arrow** Key	• Press this key to select the digit to be changed. The selected digit flashes. • Press the **Right Arrow** key to shift to the next digit on the right. • Press the **Left Arrow** key to shift to the next digit on the left.
<		**Left Arrow** Key	
JOG SVON	**SVON** Key		Press this key to perform the JOG operation with the digital operator.

Built-in Panel Operator



Key	Name	Function
	Up Arrow Key	• Press this key to set parameters or display the set values of parameters. • Press the **Up Arrow** key to increase the set value. • Press the **Down Arrow** key to decrease the set value. • Press the **Up** and **Down Arrow** keys together to reset a servo alarm.
	Down Arrow Key	
	MODE/SET Key	Press this key to select the status indicator mode, auxiliary function mode, parameter setting mode, or monitor mode.
	DATA/SHIFT Key	• Press this key to set each parameter or display the set value of each parameter. • This key is used for selecting the editing (flashing) digit or data setting.

7.1.3 Resetting Servo Alarms

Servo alarms can be reset using the digital operator.

■ Using the Hand-held Digital Operator

Press the **RESET** key in status display mode.

■ Using the Built-in Panel Operator

Press the **Up Arrow** ⊽ AND **Down Arrow** ⊼ keys together in status display mode.

The alarm can be reset with CN1-44, or /ALM-RST signal input. Refer to *5.5.1 Using Servo Alarm and Alarm Code Outputs.*

The servo alarm will be reset if the control power supply is turned OFF.

IMPORTANT

- If an alarm is ON, reset the alarm after eliminating the cause of the alarm first. Refer to *9.2 Troubleshooting.*

7.1.4 Basic Mode Selection

The basic mode selection of the digital operator is used for indicating the status of the servo amplifier in operation and setting a variety of parameters and operation references.

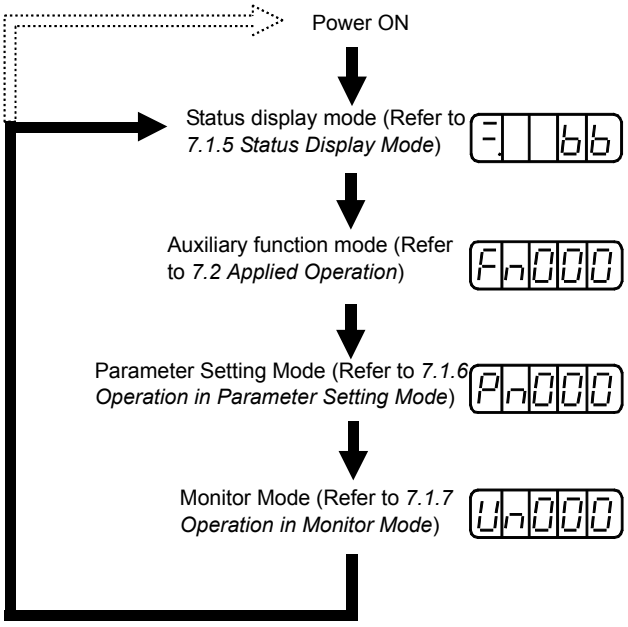
The status display, auxiliary function, parameter setting, and monitor modes are the basic modes. As shown below, the mode is selected in the following order by pressing the key.

Hand-held Digital Operator

Press the DSPL/SET Key.
The basic mode changes.

Panel Operator

Press the MODE/SET Key.
The basic mode changes.


Power ON
Status display mode (Refer to 7.1.5 Status Display Mode)
Auxiliary function mode (Refer to 7.2 Applied Operation)
Parameter Setting Mode (Refer to 7.1.6 Operation in Parameter Setting Mode)
Monitor Mode (Refer to 7.1.7 Operation in Monitor Mode)

7.1.5 Status Display Mode

In status display mode, bit data and codes are displayed to indicate the status of the servo amplifier.

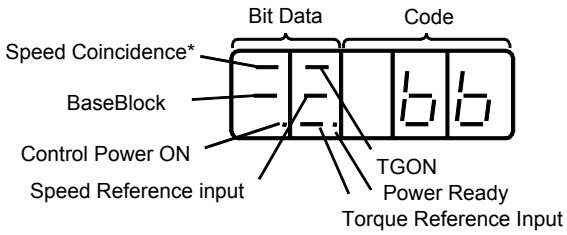
■ Selecting Status Display Mode

The digital operator goes into status display mode when the digital operation is turned ON.

■ Data in Status Display Mode

The screen contents in status display are different for speed, torque, and position control modes.

Speed and Torque Control Mode



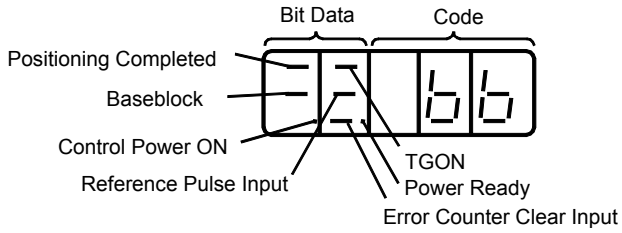
* This indicator is always lit when the Servopack is in torque control mode.

The following tables list and explain the meanings of bit data and code displays in Speed, and Torque Control Modes.

Bit Data and Meanings in Speed and Torque Control Mode	
Bit Datum	Meaning
Control Power ON	Lit when servo amplifier control power is ON.
Baseblock	Lit for baseblock. Not lit when servo is ON.
Speed Coincidence	Lit when the difference between the motor speed and reference speed is the same as or less than the value set in Pn503. (The default value set in Pn503 is 10rpm).
/TGON	Lit if motor speed exceeds preset value Preset value: Set in Pn502. (Default setting is 20rpm).
Speed Reference Input	Lit if input speed reference exceeds preset value. Specified value: Set in Pn502. (Default setting is 20rpm)
Torque Reference Input	Lit if input torque reference exceeds preset value. Preset value: 10% rated torque is default setting
Power Ready	Lit when main power supply circuit is operating at normal level. Not lit when power is OFF.

Codes and Meanings in Speed and Torque Control Mode	
Code	Meaning
bb	Baseblock Servo OFF (motor power OFF)
run	Run Servo ON (motor power ON)
Pot	Forward Run Prohibited CN1-42 (P-OT) is OFF. Refer to *5.1.2 Setting the Overtravel Limit Function.*
not	Reverse Run Prohibited CN1-43 (N-OT) is OFF. Refer to *5.1.2 Setting the Overtravel Limit Function.*
A02	Alarm Status Displays the alarm number. Refer to *9.2 Troubleshooting.*
A03	

Position Control Mode



The following tables list and explain the meanings of bit data and code displays in Position Control Mode.

Bit Data and Meanings in Position Control Mode	
Bit Datum	Meaning
Control Power ON	Lit when servo amplifier control power is ON.
Baseblock	Lit for baseblock. Not lit when servo is ON.
Positioning Completed	Lit if error between position reference and actual motor position is below preset value. Preset value: Set in PN500. (Default setting is 7 pulses).
/TGON	Lit if motor speed exceeds preset value. Preset value: Set in Pn502. (Default setting is 20rpm).
Reference Pulse Input	Lit if reference pulse is input.
Error Counter Clear Input	Lit when error counter clear signal is input.
Power Ready	Lit when main power supply circuit is operating at normal level. Not lit when power is OFF.

Codes and Meanings in Position Control Mode	
Code	Meaning
bb	Baseblock Servo OFF (motor power OFF)
run	Run Servo ON (motor power ON)
Pot	Forward Run Prohibited CN1-42 (P-OT) is OFF. Refer to *5.1.2 Setting the Overtravel Limit Function*.
not	Reverse Run Prohibited CN1-43 (N-OT) is OFF. Refer to *5.1.2 Setting the Overtravel Limit Function*.
A02	Alarm Status Displays the alarm number. Refer to *9.2 Troubleshooting*.
A03	

7.1.6 Operation in Parameter Setting Mode

Functions can be selected or adjusted by setting parameters. There are two types of parameters that can be set. One type requires value setting and the other requires function selection. These two types use different setting methods.

- With value setting, a parameter is set to a value within the specified range of the parameter.
- With function selection, the functions allocated to each digit of the seven-segment LED panel indicator (five digits) can be selected.

See *Appendix B List of Parameters.*

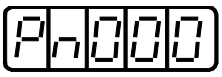
■ Changing Parameter Settings

The parameter settings can be used to change parameter data. Check the permitted range of the parameters in *Appendix B List of Parameters*, before changing the data.

The example below shows how to change parameter Pn507 from 100 to 85.

Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the parameter setting mode.

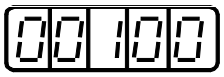


2. Select the parameter number to set. (Pn507 is selected in this example.)

Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit. The selected digit will flash.

Press tthe **Up Arrow** ⟨ or **Down Arrow** ⟨ key to change the value.

3. Press the **DATA/ENTER** key to display the current data for the parameter selected at step 2.

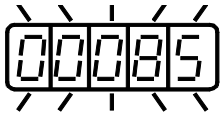


4. Change the data as needed (to 85, in this example).

Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit. The selected digit will flash.

Press the **Up Arrow** ⟨ or **Down Arrow** ⟨ key to change the value. Continue pressing the key until "00085" is displayed.

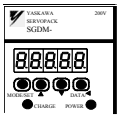
5. Press the **DATA/ENTER** key to store the data. The display will flash.



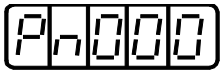
6. Press the **DATA/ENTER** key again to return to the parameter number display.

This procedure has changed the setting of the parameter Pn507 from 100 to 85. Repeat steps 2 to 6 to change the setting again.

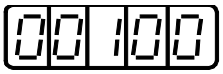
Example Using the Built-in Panel Operator



1. Press the **MODE/SET** key to select the parameter setting mode.

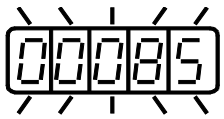


2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the parameter number to set. (Pn507 is selected in this example.)
3. Press the **DATA/SHIFT** key for a minimum of one second to display the current data for the parameter selected in step 2.

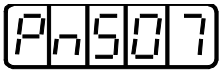


4. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to change to the desired value of "00085".

   As you keep pressing the **Up Arrow** ⊻ AND **Down Arrow** ⊼ keys, and the display changes faster.
5. Press the **DATA/SHIFT** key for a minimum of one second to save the data. The display will flash.



6. Press the **DATA/SHIFT** key once more for a minimum of one second to display the parameter number again.



This has changed the setting of the parameter Pn507 from 100 to 85.

Repeat steps 2 to 6 to change the setting again.

Note: Parameter numbers that are not defined are skipped during Operator operations.

IMPORTANT

- Press the DATA/SHIFT Key for a maximum of one second to shift to a higher (left) digit.

■ Function Selection Parameters

Types of Function Selection Parameters

The following table shows the parameters for selecting servo amplifier functions.

Category	Parameter Number	Name	Default Setting	Important Note
Function Selection Parameters	Pn000	Function Selection Basic Switches	0000	(See 1)
	Pn001	Function Selection Application Switches 1	0000	(See 1)
	Pn002	Function Selection Application Switches 2	0000	(See 1)
	Pn003	Function Selection Application Switches 3	0002	—
Gain-related Parameters	Pn10B	Gain-related Application Switches	0000	(See 2)
	Pn110	Online Autotuning Switches	0010	(See 2)
Position Control-related Parameter	Pn200	Position Control Reference Selection Switches	0000	(See 1)
Sequence-related Parameters	Pn50A	Input Signal Selections 1	2100	(See 1)
	Pn50B	Input Signal Selections 2	6543	(See 1)
	Pn50C	Input Signal Selections 3	8888	(See 1)
	Pn50D	Input Signal Selections 4	8888	(See 1)
	Pn50E	Output Signal Selections 1	3211	(See 1)
	Pn50F	Output Signal Selections 2	0000	(See 1)
	Pn510	Output Signal Selections 3	0000	(See 1)

IMPORTANT

1. After changing these parameters, turn OFF the main circuit and control power supplies and then turn them ON again to enable the new settings.
2. Changing bits Pn10B.1 and Pn110.0 require the same sequence described in note 1 (above).

Parameter settings are displayed in two patterns as shown below.

Display Application	Display	Format
Function selection	n.0000	Hexadecimal display for each digit
Parameters setting	00100	Decimal display in five digits

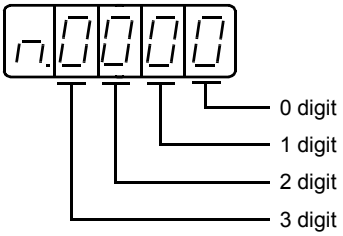
Since each digit in the function selection parameters has its own meaning, the value can only be changed for each individual digit. Each digit can only display a value within its own permitted range.

Definition of Display for Function Selection Parameters

Each digit of the function selection parameters has a unique meaning.

For example, the rightmost digit of parameter Pn000 is expressed as "Pn000.0".

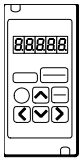
- Each digit of the function selection parameters is defined as shown below. The parameter displayed below shows how the digits in the display are assigned.



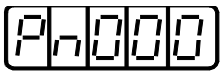
Distribution of parameter digits	
Designation	Meaning
Pn000.0	Indicates the value entered at the 0 digit of parameter Pn000.
Pn000.1	Indicates the value entered at the 1 digit of parameter Pn000.
Pn000.2	Indicates the value entered at the 2 digit of parameter Pn000.
Pn000.3	Indicates the value entered at the 3 digit of parameter Pn000.

■ Changing Function Selection Parameter Settings

Using the Hand-held Digital Operator



1. Press the **DSPL/SET** key to select the parameter setting mode.

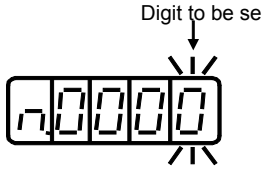


2. Select the parameter number to be set.

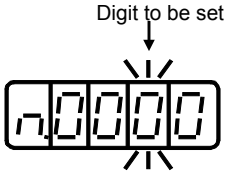
Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit. The selected digit will flash.

Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value. (Pn000 is selected in this example.)

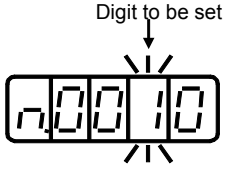
3. Press the **DATA/ENTER** key to display the current data of the parameter selected in the above step 2.



4. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.



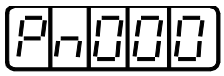
5. Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to select the value defined as a function setting for the selected digit.



Repeat the above steps 4 and 5 for changing the data as required.

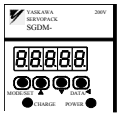
6. Press the **DATA/ENTER** key to save the data. The display will flash.

7. Press the **DATA/ENTER** key once more to return to the parameter number display.

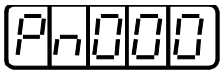


This has changed the 1 digit of parameter Pn000 to "1".

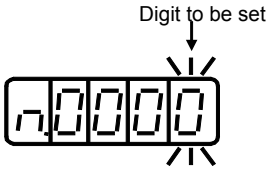
Using the Built-in Panel Operator



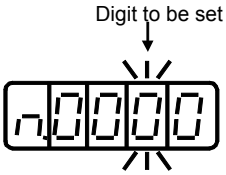
1. Press the **MODE/SET** key to select the parameter setting mode.



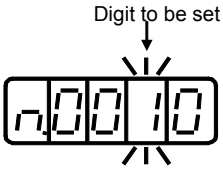
2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the parameter number to be set. (Pn000 is selected in this example.)
3. Press the **DATA/SHIFT** key for a minimum of one second to display the current data for the selected parameter.



4. Press the **DATA/SHIFT** key to select the digit to be set.



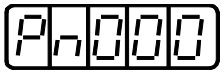
5. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the value defined as a function setting for the selected digit.



Repeat the above steps 4 and 5 for changing the data as required.

6. Press the **DATA/SHIFT** key for a minimum of one second to save the data. The display will flash.

7. Press the **DATA/SHIFT** key once more for a minimum of one second to return to the parameter number display.



This has changed the 1 digit of parameter Pn000 to "1".

7.1.7 Operation in Monitor Mode

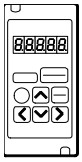
The Monitor Mode can be used for monitoring the reference values, I/O signal status, and servo amplifier internal status.

The monitor mode can be set during motor operation.

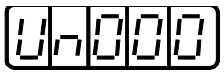
■ Using the Monitor Mode

The example below shows how to display 1500, the contents of monitor number Un000 when the Servomotor rotates at 1500rpm.

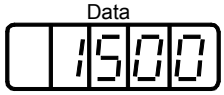
Example With the Hand-held Digital Operator



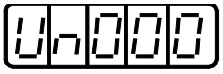
1. Press the **DSPL/SET** key to select the monitor mode.



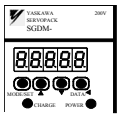
2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the monitor number to be displayed.
3. Press the **DATA/ENTER** key to display the monitor number selected in the above step 2.



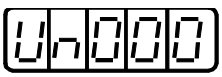
4. Press the **DATA/ENTER** key once more to return to the monitor number display.



With the Built-in Panel Operator



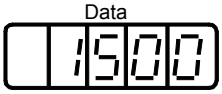
1. Press the **MODE/SET** key to select the monitor mode.



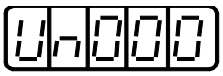
2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the monitor number to

be displayed.

3. Press the **DATA/SHIFT** key for a minimum of one second to display the monitor number selected in the above step 2.



4. Press the **DATA/SHIFT** key once more for a minimum of one second to return to the monitor number display.



This completes the example procedure for displaying 1500, the contents of monitor number Un000.

■ Contents of Monitor Mode Display

The following table shows contents of the monitor mode display.

Monitor Number	Monitor Display	Unit	Comments
Un000	Actual motor speed	rpm	—
Un001	Input speed reference	rpm	(See note 3 below)
Un002	Internal torque reference	%	Value for rated torque
Un003	Rotation angle 1	pulses	Number of pulses from the origin
Un004	Rotation angle 2	degree	Angle (electrical angle) from the origin
Un005	Input signal monitor	—	(See note 1 below)
Un006	Output signal monitor	—	(See note 1 below)
Un007	Input reference pulse speed	rpm	(See note 4 below)
Un008	Error counter value	reference unit	Positional error (See note 4 below)
Un009	Accumulated load rate	%	Value for the rated torque as 100% Displays effective torque in 10s cycle.
Un00A	Regenerative load rate	%	Value for the processable regenerative power as 100% Displays regenerative power consumption in 10s cycle.
Un00B	Power consumed by DB resistance	%	Value for the processable power when dynamic brake is applied as 100% Displays DB power consumption in 10s cycle.
Un00C	Input reference pulse counter	—	In hexadecimal (See notes 2 and 4)below
Un00D	Feedback pulse counter	—	In hexadecimal

Note: 1. Refer to *Sequence I/O Signal Monitor Display* on the next page.
2. Refer to *Reference Pulse/Feedback Pulse Counter Monitor Display* on 19.
3. Displayed only in speed control mode.
4. Displayed only in position control mode.

■ Sequence I/O Signal Monitor Display

The following section describes the monitor display for sequence I/O signals.

Input Signal Monitor Display

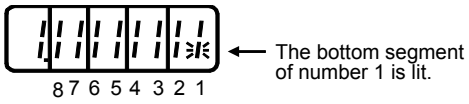
LED Number	Input Terminal Name	Default Setting
1	SI0 (CN1-40)	/S-ON
2	SI1 (CN1-41)	/P-CON
3	SI2 (CN1-42)	P-OT
4	SI3 (CN1-43)	N-OT
5	SI4 (CN1-44)	/ALM-RST
6	SI5 (CN1-45)	/P-CL
7	SI6 (CN1-46)	/N-CL
8	(CN1-4)	SEN

Note Refer to *5.3.3 Input Circuit Signal Allocation* for details on input terminals.

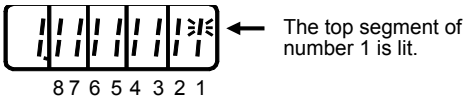
Input signals are allocated as shown above and displayed on the panel of the servo amplifier or the digital operator. They are indicated by the ON/OFF status of the vertical parts of seven-segment displays located in top and bottom rows. (The horizontal segments are not used here). These turn ON or OFF relative to the state of the corresponding input signals (ON for "L" level and OFF for "H" level).

Examples

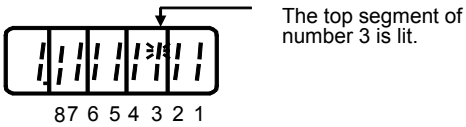
- When /S-ON signal is ON (Servo ON at "L" signal)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at "H" signal)



Output Signal Monitor Display

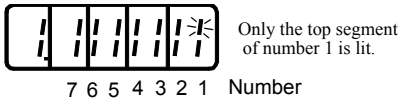
LED Number	Output Terminal Name	Default Setting
1	(CN1-31, -32)	ALM
2	SO1 (CN1-25, -26)	/COIN or /V-CMP
3	SO2 (CN1-27, -28)	/TGON
4	SO3 (CN1-29, -30)	/S-RDY
5	(CN1-37)	AL01
6	(CN1-38)	AL02
7	(CN1-39)	AL03

Note: Refer to *5.3.4 Output Circuit Signal Allocation* for details on output terminals.

Output signals are allocated as shown above and displayed on the panel of the servo amplifier or the digital operator. They are indicated by the ON/OFF status of the vertical parts of seven-segment displays located in top and bottom rows. (The horizontal segments are not used here). These turn ON or OFF relative to the state of the corresponding output signals (ON for "L" level and OFF for "H" level).

Example

- When ALM signal operates (alarm at "H")



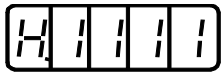
■ Reference Pulse/Feedback Pulse Counter Monitor Display

The monitor display of reference pulse counter and feedback pulse counter is expressed in 32-bit hexadecimal.

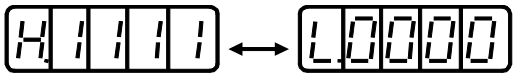
The display procedure is as follows:

Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the monitor mode.
2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select "Un00C" or "Un00D".
3. Press the **DATA/ENTER** key to display the data for the monitor number selected in the above step.



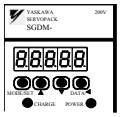
4. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to alternately display the leftmost and the rightmost 16-bit data.



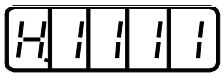
Leftmost 16-bit Data Rightmost 16-bit Data

5. Press both the **Up Arrow** ⊻ AND **Down Arrow** ⊼ keys simultaneously to clear the 32-bit counter data.
6. Press the **DATA/ENTER** key once more to return to the monitor number display.

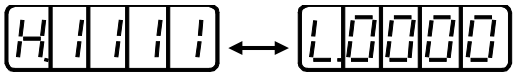
Using the Built-in Panel Operator



1. Press the **MODE/SET** key to select the monitor mode.
2. Press the **Up Arrow** ⊻ AND **Down Arrow** ⊼ keys to select "Un00C" or "Un00D".
3. Press the **DATA/SHIFT** key for a minimum of one second to display the data for the monitor number selected in the above step.



4. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to alternately display the leftmost 16-bit data and rightmost 16-bit data.



Leftmost 16-bit Data Rightmost 16-bit Data

5. Press both the **Up Arrow** ⊽ AND **Down Arrow** ⊼ keys simultaneously to clear the 32-bit counter data.
6. Press the **DATA/SHIFT** key once more for a minimum of one second to return to the monitor number display.

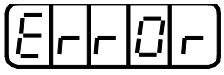
7.2 Applied Operation

This section describes how to apply the basic operations using the digital operator to run and adjust the motor. Read the basic operations described in *7.1 Basic Operation* before proceeding to this section.

Parameters for applied operation can be set in the auxiliary function mode. The following table shows the parameters in the auxiliary function mode.

Parameter Number	Function	Comments
Fn000	Alarm traceback data display	—
Fn001	Rigidity setting during online auto-tuning	(See note).
Fn002	JOG mode operation	—
Fn003	Zero-point search mode	
Fn004	(Reserved parameter)	
Fn005	Parameter settings initialization	(See note).
Fn006	Alarm traceback data clear	
Fn007	Writing to EEPROM the inertia ratio data obtained from online auto-tuning	
Fn008	Absolute encoder multi-turn reset and encoder alarm reset.	
Fn009	Automatic tuning of analog (speed, torque) reference offset	
Fn00A	Manual adjustment of speed reference offset	
Fn00B	Manual adjustment of torque reference offset	
Fn00C	Manual zero-adjustment of analog monitor output	
Fn00D	Manual gain-adjustment of analog monitor output	
Fn00E	Automatic offset-adjustment of motor current detection signal	
Fn00F	Manual offset-adjustment of motor current detection signal	
Fn010	Password setting (protects from parameter changes)	—
Fn011	Motor models display	
Fn012	Software version display	
Fn013	Change Multi-Turn Limit Setting Value when a Multi-Turn Limit Disagreement Alarm occurs	(See note).
Fn014	Clear of option unit detection results	(See note).

Note: These parameters and those indicated as Pn□□□ are displayed as shown below if their write protect is set (Fn010). These parameters cannot be changed.



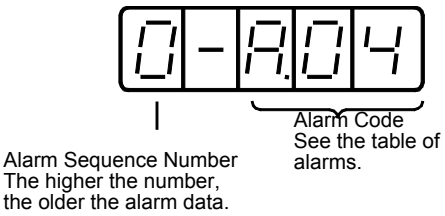
Flashing for one second

7.2.1 Operation in Alarm Traceback Mode

The Alarm Traceback Mode can display up to ten alarms that have occurred, thus making it possible to check what kind of alarms have been generated.

The alarm traceback data is not cleared on alarm reset or when the servo amplifier power is turned OFF.

The data can be cleared using the special "clear alarm traceback mode." Refer to *7.2.5 Clearing Alarm Traceback Data* for details.



■ Checking Alarms

Follow the procedure below to determine which alarms have been generated.

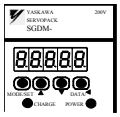
Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the "Displaying alarm traceback data (Fn000)" in the auxiliary function mode.

2. Press the **DATA/ENTER** key, and the alarm traceback data will be displayed.
3. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to scroll the alarm sequence numbers up or down and display information on previous alarms.

   The higher the leftmost digit (alarm sequence number), the older the alarm data.

Using the Built-in Panel Operator



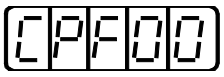
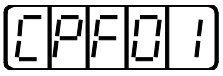
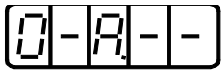
1. Press the **MODE/SET** key to select the "Displaying alarm traceback data (Fn000)" in the auxiliary function mode.

2. Press the **DATA/SHIFT** key for a minimum of one second to display the alarm traceback data.
3. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to scroll the alarm sequence numbers up or down and display information on previous alarms.

The higher the leftmost digit (alarm sequence number), the older the alarm data.

For descriptions of each alarm code, refer to *9.2 Troubleshooting*.

The following are operator-related alarms which are not recorded in the traceback data.

Display	Description
	Digital operator transmission error 1
	Digital operator transmission error 2
	No error detected.

Note: Alarm traceback data is not updated when the same alarm occurs repeatedly.

7.2.2 JOG Operation Using the Digital Operator

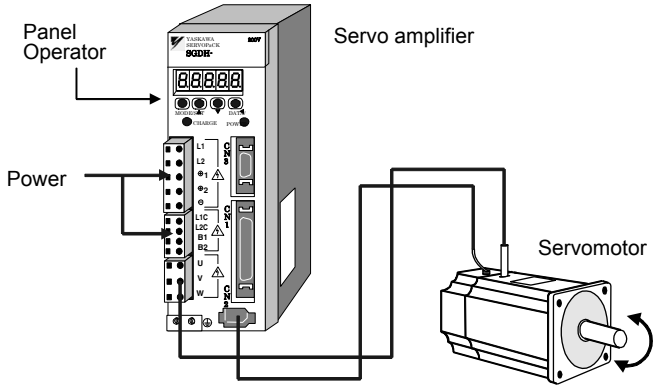
CAUTION

- Forward run prohibited (/P-OT) and reverse run prohibited (/N-OT) signals are not effective during JOG operations using parameter Fn002.

Operation from the digital operator allows the servo amplifier to run the motor. This allows rapid checking of motor's rotation direction and speed setting during machine setup and testing, saving the time and trouble of connecting to a host controller.

For motor speed setting procedure, refer to *7.1.6 Operation in Parameter Setting*

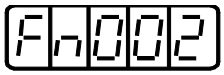
Mode and *5.3.2 JOG Speed.*



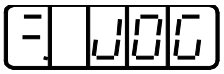
Operation procedure using the digital operator is described on the following pages.

Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select Fn002 in the auxiliary function mode.

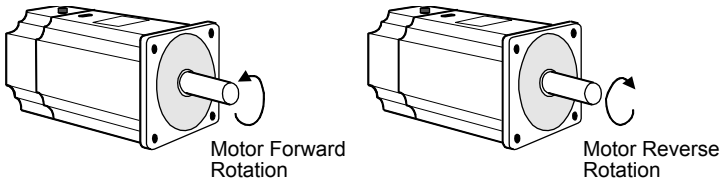


2. Press the **DATA/ENTER** key to select the digital operator operation mode. Operation is now possible using the digital operator.

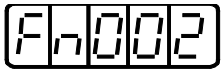


3. Press the **SVON** key to set to the servo ON state (with motor power turned ON).

4. Press the **Up Arrow** ⊙ or **Down Arrow** ⊙ key to operate the motor. The motor keeps operating while the key is pressed.

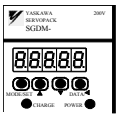


5. Press the **MODE/SET** key, and the display will revert to Fn002. This sets to the servo OFF state (with motor power turned OFF). Alternatively, press the SVON Key to set to the servo OFF state.

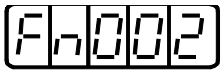


This ends JOG operation under digital operator control.

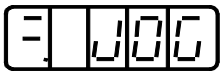
Using the Built-in Panel Operator



1. Press the **MODE/SET** key to select Fn002 in the auxiliary function mode.

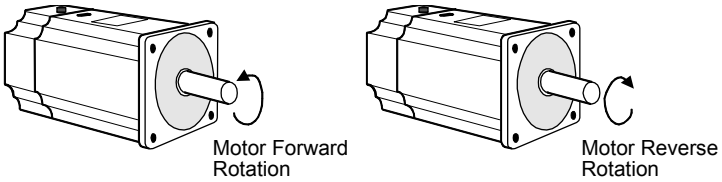


2. Press the **DATA/SHIFT** key for a minimum of one second to select the Panel Operator Operation Mode. Operation is now possible using the panel operator.

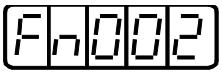


3. Press the **MODE/SET** key to set to the servo ON (with motor power turned ON).

4. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to operate the motor. The motor keeps operating while the key is pressed.



5. Press the **MODE/SET** key to set to the servo OFF state (with motor power turned OFF). Alternatively, press the **DATA/SHIFT** key for a minimum of one second to set to the servo OFF state.
6. Press the **DATA/SHIFT** key for a minimum of one second, and the display will revert to Fn002 in the auxiliary function mode.



This ends JOG operation under panel operator control.

The motor speed for operation under digital operator control can be changed with a parameter:

Parameter	Signal	Setting (rpm)	Application
Pn304	Jog Speed	Default Setting: 500	Speed Control

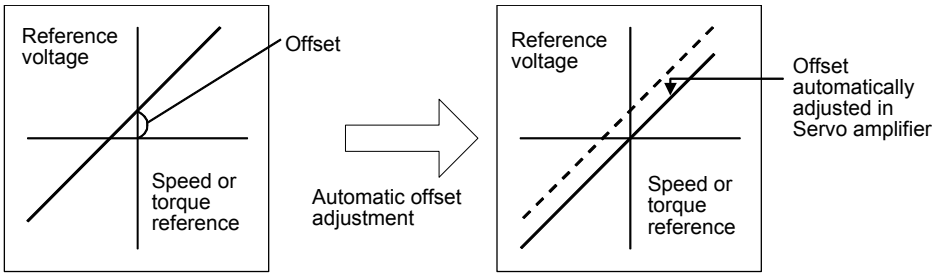
Note: The rotation direction of the servomotor depends on the setting of parameter Pn000.0 "Rotation Direction." The above example shows a case where Pn000.0 is set to "0" as a default setting.

7.2.3 Automatic Adjustment of the Speed and Torque Reference Offset

When speed and torque control are used, the motor may rotate slowly even when 0V is specified as the analog reference voltage. This occurs when the host controller or external circuit has a small offset (measured in mV) in the reference voltage.

The Automatic Reference Offset Adjustment Mode automatically measures the offset and adjusts the reference voltage. It adjusts both the speed and torque references.

The following diagram illustrates automatic adjustment of an offset in the reference voltage by the servo amplifier.



After completion of automatic offset adjustment, the amount of offset is stored in the servo amplifier.

The amount of offset can be checked in the Speed Reference Offset Manual Adjustment Mode. Refer to *7.2.4 Manual Adjustment of the Speed and Torque Reference Offset* for details.

The automatic reference offset adjustment mode cannot be used for setting the error pulses to zero for a stopped servo amplifier when a position loop is formed with a host controller. In such cases, use the manual reference offset adjustment mode. Refer to *7.2.4 Manual Adjustment of the Speed and Torque Reference Offset* for details.

The zero-clamp speed control function is available to force the motor to stop while the zero speed reference is given. Refer to *5.4.3 Using the Zero Clamp Function.*

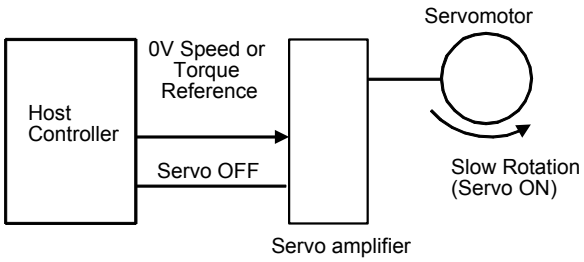
IMPORTANT

- Automatic adjustment of the speed/torque reference offset must be performed under the servo OFF state.

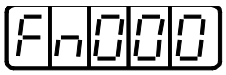
Follow this procedure to automatically adjust the speed/torque reference offset.

Using the Hand-held Digital Operator

1. Input the (intended) 0V reference voltage from the host controller or external circuit.



2. Press the **DSPL/SET** key to select the auxiliary function mode.

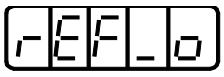


3. Select the parameter Fn009.

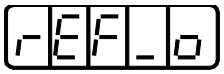
Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.

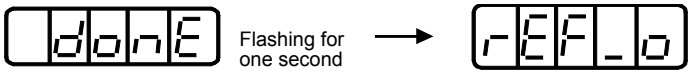
4. Press the **DATA/ENTER** key, and the display will be as shown below.



5. Press the **MODE/SET** key, and the following display will flash for one second.



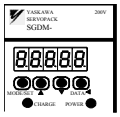
The reference offset will be automatically adjusted.



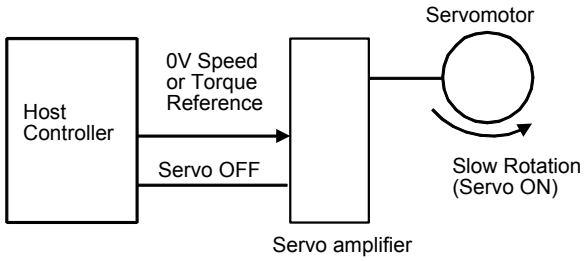
6. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

This completes the speed/torque reference offset automatic adjustment.

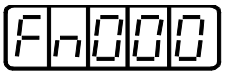
Using the Built-in Panel Operator



1. Input the (intended) 0V reference voltage from the host controller or external circuit.

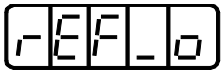


2. Press the **MODE/SET** key to select the auxiliary function mode.

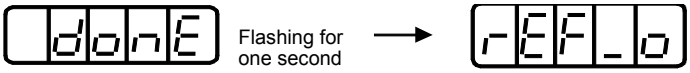


3. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to select the parameter Fn009.

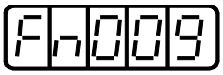
4. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



5. Press the **MODE/SET** key, and the following display will flash for one second. The reference offset will be automatically adjusted.



6. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



This completes the speed/torque reference offset automatic adjustment.

7.2.4 Manual Adjustment of the Speed and Torque Reference Offset

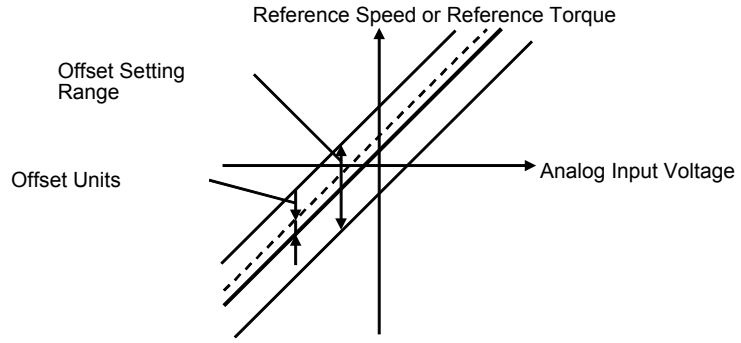
Manual speed/torque reference offset adjustment is useful in the following situations:

- If a position loop is formed with a host controller and the error zeroed-out when the motor was stopped in servo lock (zero reference).
- To deliberately set the offset to some value.

This mode can also be used to check the data set in the Automatic Reference Offset Adjustment Mode.

In principle, this mode operates in the same way as the Automatic Reference Offset

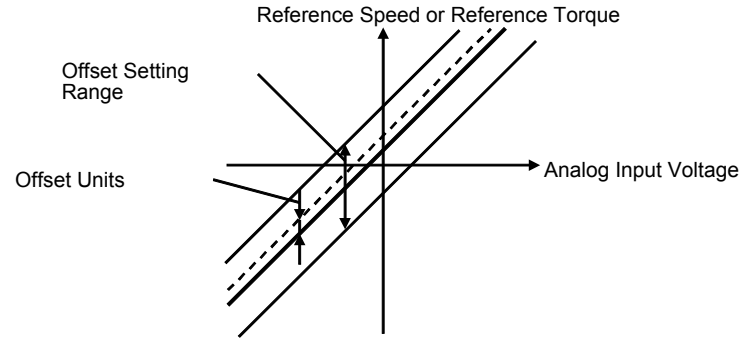
Adjustment Mode, except that the amount of offset is directly input during the adjustment. The offset amount can be set in the speed reference or torque reference. The offset setting range and setting units are as follows:



Offset Setting Range	Offset Setting Range
16Bit – Speed Reference: -9999 to +9999	Speed Reference: 0.58mV/LSB
11Bit – Torque Reference: -128 to +127	Torque Reference: 1.47mV/LSB

The speed reference input and torque reference input offset adjustment ranges for the new Sigma II amplifiers (version # 33□□□ or higher) have finer resolution than the standard Sigma II amplifiers. The figure below shows the offset adjustment ranges and resolutions for new Sigma II amplifiers:

Sigma II Amplifier with version #33□□□ or higher

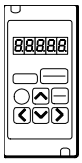


Offset Setting Range	Offset Setting Range
24Bit – Speed Reference: +15000 to -15000	Speed Reference: 0.05mV/LSB
16Bit – Torque Reference: +9999 to -9999	Torque Reference: 0.5mV/LSB

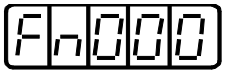
■ Manual Adjustment of Speed Reference Offset

Follow the procedure below to manually adjust the speed reference offset.

Using the Hand-held Digital Operator



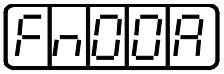
1. Press the **DSPL/SET** key to select the auxiliary function mode.



2. Select the parameter Fn00A.

   Press the **Up Arrow** ⊗ or **Down Arrow** ⊗ key to select the digit.

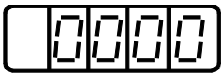
   Press the **Up Arrow** ⊗ or **Down Arrow** ⊗ key to change the value.



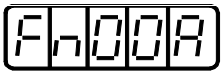
3. Press the **DATA/ENTER** key, and the display will be as shown below. The manual adjustment mode for the speed reference offset will be entered.

4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

5. Press the **Left Arrow** ⊗ or **Right Arrow** ⊗ key, to display the speed reference offset amount.

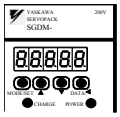


6. Press the **Up Arrow** ⊗ or **Down Arrow** ⊗ key to adjust the amount of offset (adjustment of the speed reference offset).
7. Press the Right Cursor Key to return to the display shown in the above step 4.
8. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

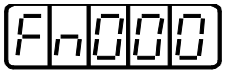


This completes the speed reference offset manual adjustment.

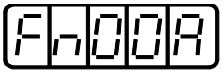
Using the Built-in Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.



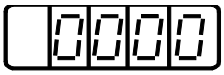
2. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to select the parameter Fn00A.



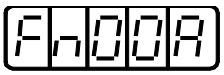
3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below. The manual adjustment mode for the speed reference offset will be entered.

4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

5. Press the **DATA/SHIFT** key for less than one second to display the speed reference offset amount.



6. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to adjust the amount of offset (adjustment of the speed reference offset).
7. Press the **DATA/SHIFT** key for less than one second to return to the display shown in the above step 4.
8. Press the **DATA/SHIFT** key to return to the auxiliary function mode display.

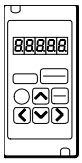


This completes the speed reference offset manual adjustment.

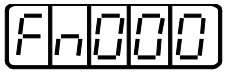
■ Manual Adjustment of Torque Reference Offset

Follow the procedure below to manually adjust the torque reference offset.

Using the Hand-held Digital Operator



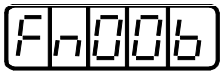
1. Press the **DSPL/SET** key to select the auxiliary function mode.



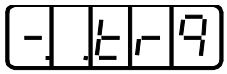
2. Select the parameter Fn00B.

   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

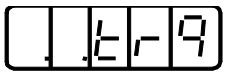
   Press the **Up Arrow** ⟨ or **Down Arrow** ⟨ key to change the value.



3. Press the **DATA/ENTER** key, and the display will be as shown below. The manual adjustment mode for the torque reference offset will be entered.



4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.

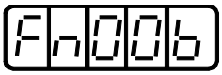


5. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to display the torque reference offset amount.

6. Press the **Up Arrow** ⟨ or **Down Arrow** ⟨ key to adjust the offset amount (adjustment of torque reference offset).

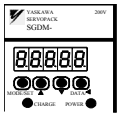
7. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key, and the display will be as shown above in step 4.

8. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

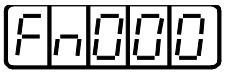


   This completes the torque reference offset manual adjustment.

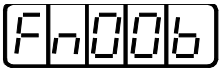
Using the Built-in Panel Operator



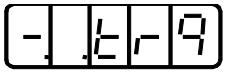
1. Press the **MODE/SET** key to select the auxiliary function mode.



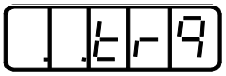
2. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to select the parameter Fn00B.



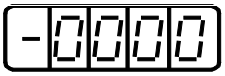
3. Press the **MODE/SET** key for a minimum of one second, and the display will be as shown below. The manual adjustment mode for the torque reference offset will be entered.



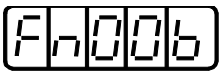
4. Turn ON the Servo ON (/S-ON) signal. The display will be as shown below.



5. Press the **DATA/SHIFT** key for less than one second, to display the torque reference offset amount.



6. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to adjust the offset amount, (Adjustment of torque reference offset).
7. Press the **DATA/SHIFT** key for less than one second, and the display will be as shown in the above step 4.
8. Press the **DATA/SHIFT** key to return to the auxiliary function mode.



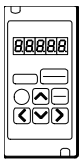
This completes the torque reference offset manual adjustment.

7.2.5 Clearing Alarm Traceback Data

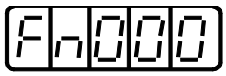
This procedure clears the alarm history, which stores the alarms generated in the servo amplifier. After clearing, each alarm in the alarm history is set to A.- -, which is not an alarm code. Refer to *7.2.1 Operation in Alarm Traceback Mode* for details.

Follow the procedure below to clear the alarm traceback data.

Using the Hand-held Digital Operator



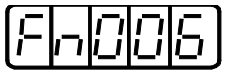
1. Press the **DSPL/SET** key to select the auxiliary function mode.

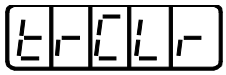
2. Select the parameter Fn006.

   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

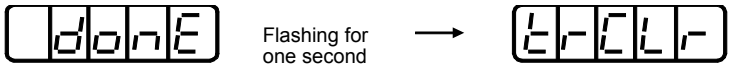
   Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.

3. Press the **DATA/ENTER** key, and the display will be as shown below.

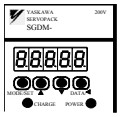
4. Press the **MODE/SET** key to clear the alarm traceback data. The following display will flash for one second, and, after the alarm traceback data is cleared, the display will return to the one in the above step 3.

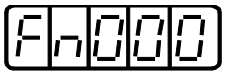
5. Press the **DATA/ENTER** key to return to the parameter code display.

   This completes the alarm traceback data clearing procedure.

Using the Built-in Panel Operator

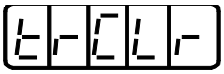


1. Press the **MODE/SET** key to select the auxiliary function mode.

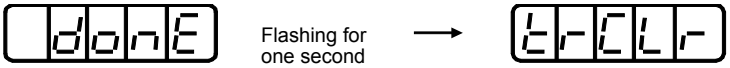


2. Press the **Up Arrow** ⊗ or **Down Arrow** ⊗ key to select the parameter Fn006.

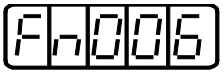
3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



4. Press the **MODE/SET** key to clear the alarm traceback data. The following display will flash for one second, and, after the alarm traceback data is cleared, the display will return to the one shown above in step 3.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the parameter code display.



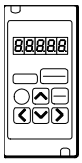
This completes the alarm traceback data clearing procedure.

7.2.6 Checking the Motor Model

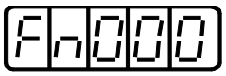
Set the parameter Fn011 to select the Motor Model Check Mode. This mode is used for motor maintenance, and can also be used to check the special (Y-specification) codes of the servo amplifiers.

Follow the procedure below to check the motor model.

Using the Hand-held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

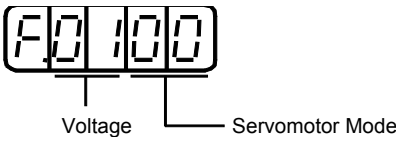


2. Select the parameter Fn011.

   Press the **Left Arrow** ⊗ or **Right Arrow** ⊗ key to select the digit.

Press the **Up Arrow** ▽ or **Down Arrow** △ key to change the value.

3. Press the **DATA/ENTER** key to display the servomotor model and voltage code.



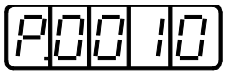
Voltage

Code	Voltage
00	$100V_{AC}$ or $140V_{DC}$
01	$200V_{AC}$ or $280V_{DC}$
02	$400V_{AC}$ or $560V_{DC}$

Servomotor Model

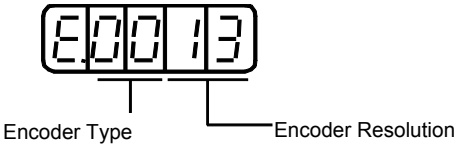
Code	Servomotor Model
00	SGMAH
01	SGMPH
02	SGMSH
03	SGMGH-□A (1500rpm)
04	SGMGH-□B (1000rpm)
05	SGMDH
06	SGMUH

4. Press the **MODE/SET** key to display the Servomotor capacity.



Capacity: Displayed value × 10W.
In this example, the capacity is 100W.

5. Press the **DSPL/SET** key to display the encoder type and resolution code.



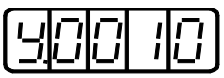
Encoder Type

Code	Voltage
00	Incremental Encoder
01	Absolute Encoder

Encoder Resolution

Code	Resolution
13	13 bits
16	16 bits
17	17 bits
20	Reserved

6. Press the **DSPL/SET** key to display the servo amplifier's special (Y-specification) code.



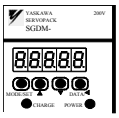
This example shows specification code "Y10" (indicated in decimal).

7. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

Pressing the **DATA/ENTER** key after the above displays in steps 3 to 5 will also return to the auxiliary function mode display.

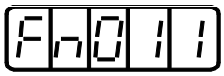
This completes checking motor type procedure.

Using the Built-in Panel Operator

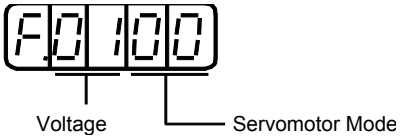


1. Press the **MODE/SET** key to select the auxiliary function mode.

2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the parameter Fn011.



3. Press the **DATA/SHIFT** key for a minimum of one second to display the servomotor model and voltage code.



Voltage

Code	Voltage
00	$100V_{AC}$ or $140V_{DC}$
01	$200V_{AC}$ or $280V_{DC}$
02	$400V_{AC}$ or $560V_{DC}$

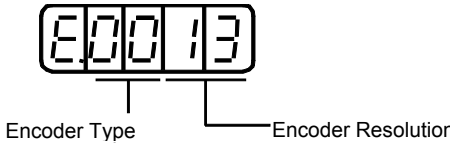
Servomotor Model

Code	Servomotor Model
00	SGMAH
01	SGMPH
02	SGMSH
03	SGMGH-□A (1500rpm)
04	SGMGH-□B (1000rpm)
05	SAGMDH
06	SGMUH

4. Press the **MODE/SET** key to display the Servomotor capacity.

Capacity: Displayed value × 10W.
In this example, the capacity is 100W.

5. Press the **MODE/SET** key, and the encoder type and resolution code will be displayed.



Encoder Type

Code	Voltage
00	Incremental Encoder
01	Absolute Encoder

Encoder Resolution

Code	Resolution
13	13 bits
16	16 bits
17	17 bits
20	Reserved

6. Press the **MODE/SET** key to display the servo amplifier's special (Y-specification) code.

This example shows specification code "Y10" (indicated in decimal).

7**.** Press the **DATA/SHIFT** key to return to the auxiliary function mode display.

Pressing the **DATA/SHIFT** key after the above displays in steps 3 to 5 will also return to the auxiliary function mode display.

This completes the motor type checking procedure.

7.2.7 Checking the Software Version

Set Fn012 to select the Software Version Check Mode.

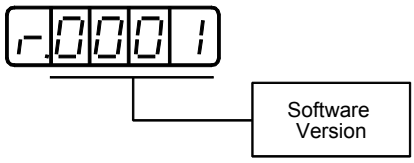
This mode is used for motor maintenance.

Follow the procedure below to check the software version.

Using the Hand-held Operator

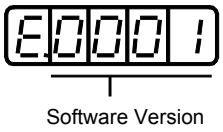
1. Select the parameter Fn012.
2. Press the **DATA/ENTER** key, and the servo amplifier software version will be displayed.

Software Version Display



3. Press the **DSPL/SET** key, and the software version of the encoder mounted on the motor will be displayed.

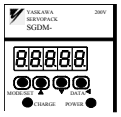
Software Version Display



4. Press the **DATA/ENTER** key to return to the parameter code display.

This completes the checking software version procedure.

Using the Built-in Panel Operator



1. Select the parameter Fn012.
2. Press the **DATA/SHIFT** key for a minimum of one second to display the servo amplifier software version.
3. Press the **MODE/SET** key to display the encoder software version.
4. Press the **DATA/SHIFT** key for a minimum of one second to return to the parameter code display.

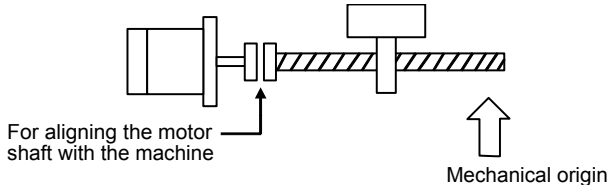
7.2.8 Origin Search Model

CAUTION

- Forward run prohibited (/P-OT) and reverse run prohibited (/N-OT) signals are not effective during jog operations using parameter Fn003.

The Origin Search Mode is designed to position the origin pulse position of the encoder and to clamp at the position. This mode is used when the motor shaft needs to be aligned to the machine. Execute the origin search without connecting the couplings.

The speed for executing the origin search is 60rpm.

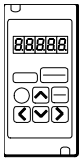


The following conditions must be met to perform the origin search operation.

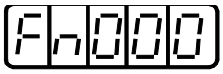
- If the Servo-ON input signal (/S-ON) is ON, turn it OFF.
- Release the Servo-ON signal mask if the parameter Pn50A.1 is set to 7, and the servo has been set to be always ON.

Follow the procedure on the next page to execute the origin search.

Using the Hand-held Digital Operator



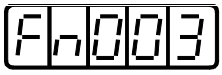
1. Press the **DSPL/SET** key to select the auxiliary function mode.



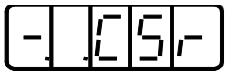
2. Select the parameter Fn003.

   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

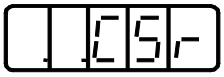
   Press the **Up Arrow** ⌃ or **Down Arrow** ⌄ key to change the value.



3. Press the **DATA/ENTER** key, and the display will be as shown below.

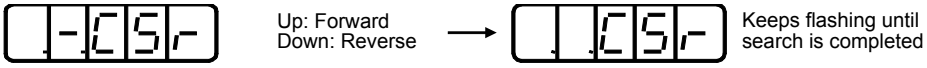


4. Press the **SVON** key, and the display will be as shown below. Now it is ready for executing the origin search.

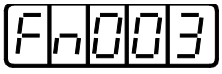


5. Hold down the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to execute the origin search.

   When the parameter is set to Pn000.0 = 0 (default), pressing the **Up Arrow** ⌄ key will rotate the motor in the forward direction. Pressing the **Down Arrow** ⌃ key will rotate the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the rotation of the motor is reversed.

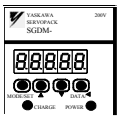


6. Press the **DATA/ENTER** key to return to the auxiliary function mode display.



   This completes the origin search operation.

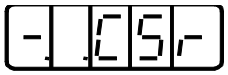
Using the Built-in Panel Operator



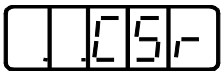
1. Press the **MODE/SET** key to select the auxiliary function mode.

2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the parameter Fn003.

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



4. Press the **DSPL/SET** key, and the display will change as shown below. Now it is ready for executing the origin search mode.



5. Hold down the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to execute the origin search.

   When the parameter is set to Pn000.0 = 0 (default), pressing the **Up Arrow** ⊼ key will rotate the motor in the forward direction. Pressing the **Down Arrow** ⊻ key will rotate the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the rotation of the motor is reversed.

6. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

   This completes the origin search operation.

7.2.9 Initializing Parameter Settings

This function is used to restore all the parameters to the default settings (standard factory settings).

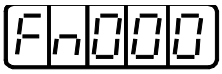
IMPORTANT

- **Initialize the parameter settings with the servo OFF.**
- **After performing the procedure, cycle the power to restore all the parameters to the default settings.**

Follow the procedure below to initialize parameter settings.

Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the auxiliary function mode.

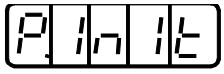


2. Select the parameter Fn005.

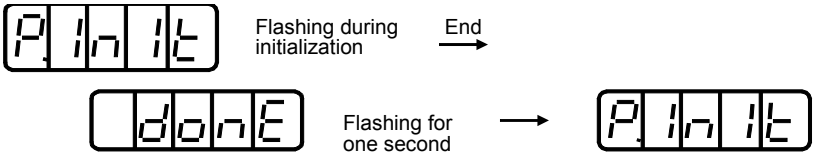
   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

   Press the **Up Arrow** ⟨ or **Down Arrow** ⟨ key to change the value.

3. Press the **DATA/ENTER** key, and the display will be as shown below.



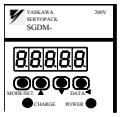
4. Press the **DSPL/SET** key, and the display will be as shown below. The parameters will be initialized.



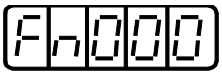
5. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

This completes the initialization of parameter settings.

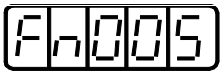
Using the Built-in Panel Operator



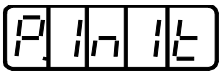
1. Press the **MODE/SET** key to select the auxiliary function mode.



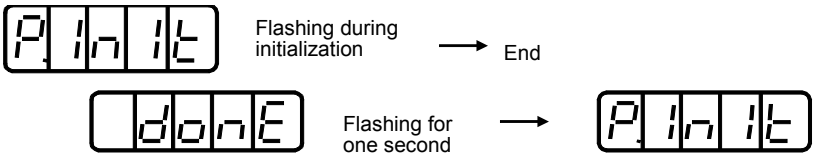
2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the parameter Fn005.



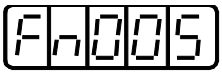
3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



4. Press the **MODE/SET** key, and the display will be as shown below. The parameters will be initialized.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



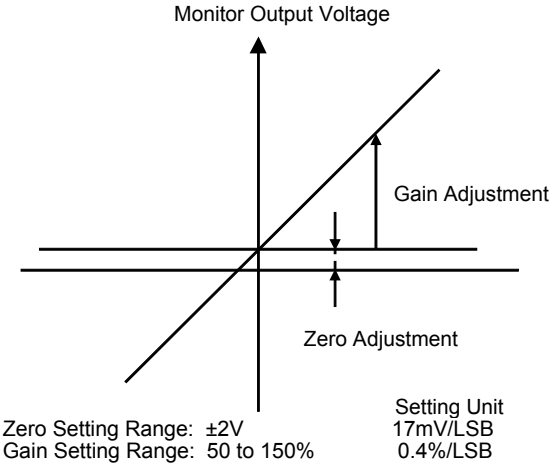
This completes the initialization of parameter settings.

Note: Parameters will not be initialized by pressing the **DSPL/SET** or **MODE/SET** key with the servo ON. Turn the power OFF and then back ON after initialization.

7.2.10 Manual Zero Adjustment and Gain Adjustment of Analog Monitor Output

Motor speed, torque reference, and position error can be monitored through the analog monitor output. Refer to *6.5 Analog Monitor*.

Use the manual zero adjustment function to compensate for the output voltage drift or the zero point drift caused by noise entering the monitor system. The gain adjustment function can be changed to match the sensitivity of the measuring system.



Note: The output voltage of the analog monitor is ±8V. The output voltage polarity will be reversed if ±8V is exceeded.

■ Manual Zero Adjustment of Analog Monitor Output

Follow the procedure below to execute the manual zero adjustment of analog monitor output.

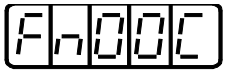
Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the auxiliary function mode.

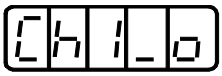
2. Select the parameter Fn00C.

Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

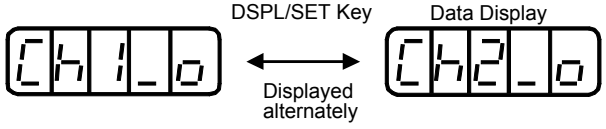
Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.



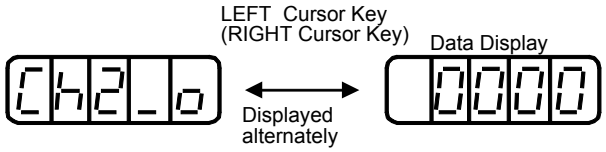
3. Press the **DATA/ENTER** key, and the display will be as shown below.



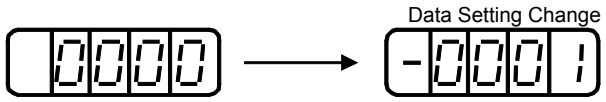
4. Press the **DSPL/SET** key. Each time the **MODE/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.



5. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to display the analog monitor output data. Pressing the **Left Arrow** ⟨ or **Right Arrow** ⟨ key again will return to the display shown in the above step 3 or 4.



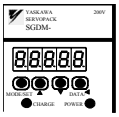
6. Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to perform zero adjustment of the analog monitor output.



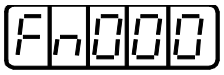
7. When zero adjustment has been completed for the two channels, press the **DATA/ENTER** key to return to the auxiliary function mode display.

This completes the manual zero adjustment of the analog monitor output.

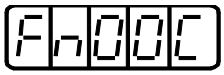
Using the Built-in Panel Operator



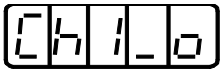
1. Press the **MODE/SET** key to select the auxiliary function mode.



2. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to select the parameter Fn00C.

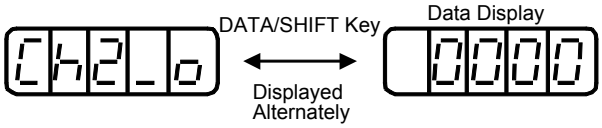


3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



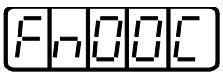
4. Press the **MODE/SET** key. Each time the **MODE/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.

5. Press the **DATA/SHIFT** key for less than one second, and the analog monitor gain parameter will be displayed. Pressing the **DATA/SHIFT** key again for less than one second will return to the display shown in the above steps 3 or 4.



6. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to perform zero adjustment of the analog monitor output.

7. When zero adjustment has been completed for the two channels, press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



This completes the manual zero adjustment of the analog monitor output.

■ Manual Gain Adjustment of Analog Monitor Output

Follow the procedure below to execute the manual gain adjustment of analog monitor output.

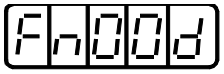
Using the Hand-held Digital Operator

1. Press the **DSPL/SET** key to select the auxiliary function mode.

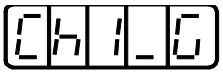
2. Select the parameter Fn00D.

Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

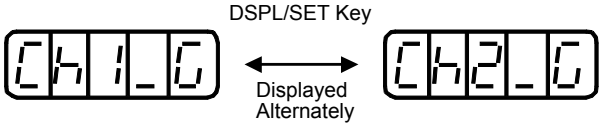
Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.



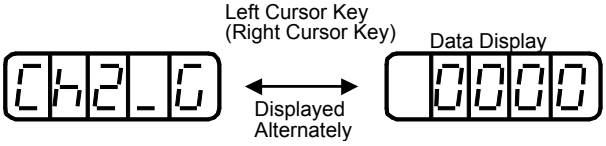
3. Press the **DATA/SHIFT** key, and the display will be as shown below.



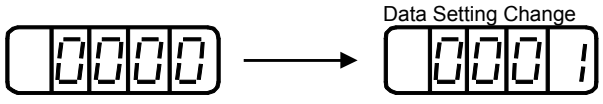
4. Press the **DSPL/SET** key. Each time the **DSPL/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.



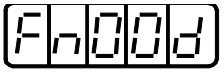
5. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to display the analog monitor gain parameter. Pressing the **Left Arrow** ⟨ or **Right Arrow** ⟨ key again will return to the display shown above in step 3 or 4.



6. Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to adjust the gain for the analog monitor output.

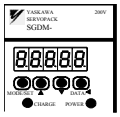


7. When the gain adjustment has been completed for the two channels, press the **DATA/ENTER** key to return to the auxiliary function mode display.



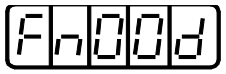
This completes the manual gain adjustment of the analog monitor output.

Using the Built-in Panel Operator

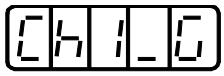


1. Press the **MODE/SET** key to select the auxiliary function mode.

2. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the parameter Fn00D.

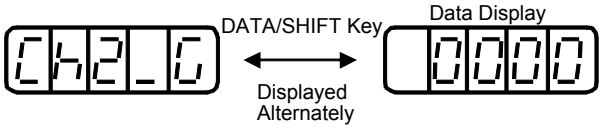


3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

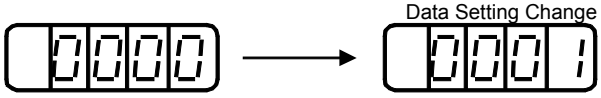


4. Press the **MODE/SET** key. Each time the **MODE/SET** key is pressed, the monitor output will toggle between the displays for the two channels shown below.

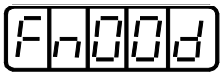
5. Press the **DATA/SHIFT** key for less than one second. The gain parameter for the analog monitor will be displayed. Pressing the **DATA/SHIFT** key again for less than one second will return to the display shown above in step 3 or 4.



6. Press the **Up Arrow** ⟩ or **Down Arrow** ⟩ key to adjust the gain for the analog monitor output.



7. When the gain adjustment has been completed for the two channels, press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



This completes the manual gain adjustment of the analog monitor output.

7.2.11 Adjusting the Motor Current Detection Offset

Motor current detection offset adjustment is performed at Yaskawa before shipping. Normally, the user does not need to perform this adjustment. Make this adjustment only if highly accurate adjustment is required to reduce torque ripple caused by current offset.

⚠ CAUTION

- **If this function, particularly manual adjustment, is executed carelessly, it may degrade the performance of the servo drive.**

The following sections describe automatic and manual adjustment of the current detection offset.

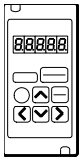
■ Automatic Adjustment of the Motor Current Detection Offset

IMPORTANT

- **Automatic adjustment is possible only with power supplied to the main circuits ON and with the servo OFF.**

Use the following procedure to perform automatic adjustment of the current detection offset.

Using the Hand-held Digital Operator

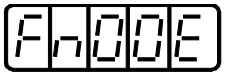


1. Press the **DSPL/SET** key to select the auxiliary function mode.

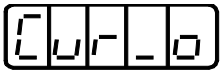
2. Select the parameter Fn00E.

   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

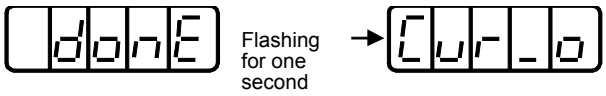
   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to change the value.



3. Press the **DATA/ENTER** key, and the display will be as shown below.



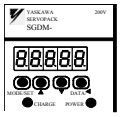
4. Press the **DSPL/SET** key. The display will change as shown below and offset will be automatically adjusted.



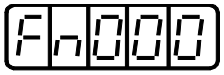
5. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

This completes the automatic adjustment of the motor current detection offset.

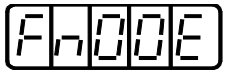
Using the Built-in Panel Operator



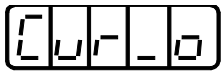
1. Press the **MODE/SET** key to select the auxiliary function mode.



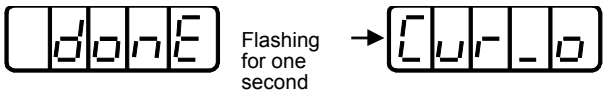
2. Press the **Up Arrow** ⊽ or **Down Arrow** ⊼ key to select the parameter Fn00E.



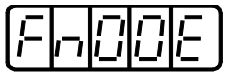
3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



4. Press the **MODE/SET** key. The display will change as shown below and the offset will be automatically adjusted.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



This completes the automatic adjustment of the motor current detection offset.

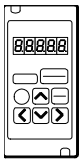
■ Manually Adjusting the Motor Current Detection Offset

Follow the procedure below to manually adjust the current detection offset.

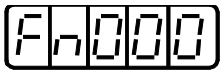
IMPORTANT

- **When making manual adjustments, run the motor at a speed of approximately 100rpm, and adjust the Motor Current Detection Offset until the torque ripple, observed with the analog monitor, is minimized.** (Refer to *Section 6.5 Analog Monitor.)*
  Adjust the U-phase and V-phase offsets alternately several times until these offsets are well balanced.

Using the Hand-held Digital Operator



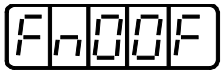
1. Press the **DSPL/SET** key to select the auxiliary function mode.



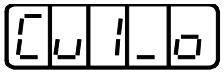
2. Select the parameter Fn00F.

   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

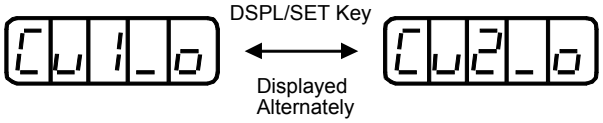
   Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.



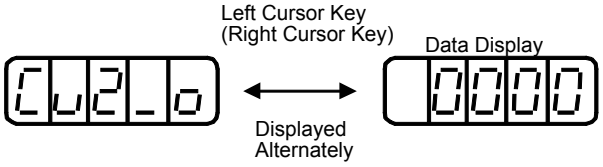
3. Press the **DATA/ENTER** key, and the display will be as shown below.



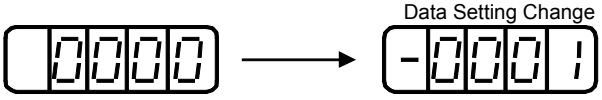
4. Press the **DSPL/SET** key to switch between the U-phase (Cu1_0) and V-phase (Cu2_0) current detection offset adjustment mode



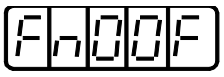
5. Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to display the current detection data. Pressing the **Left Arrow** ⟨ or **Right Arrow** ⟨ key again will return to the display shown above in step 3 or 4.



6. Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal.

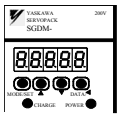


7. When the current offset adjustment has been completed for the U-phase (Cu1_0) and V-phase (Cu2_0), press the **DATA/SHIFT** key to return to the auxiliary function mode display.



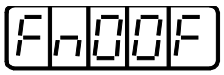
This completes the manual adjustment of the motor current detection offset.

Using the Built-in Panel Operator

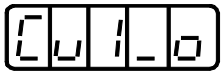


1. Press the **MODE/SET** key to select the auxiliary function mode.

2. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to select the parameter Fn00F.

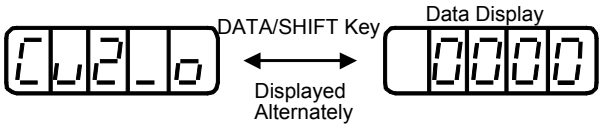


3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.

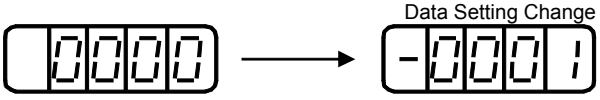


4. Press the **MODE/SET** key to switch between U-phase (Cu1_0) and V-phase (Cu2_0) current detection offset adjustment mode.

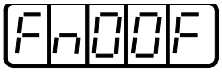
5. Press the **DATA/SHIFT** key for less than one second to display the current detection data. Press the **DATA/SHIFT** key again for less than one second, and the display will return to one shown above in step 3 or 4.



6. Press the **Up Arrow** ⊻ or **Down Arrow** ⊼ key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal.



7. When the current offset adjustment has been completed for the U-phase (Cu1_0) and V-phase (Cu2_0), press the **DATA/SHIFT** key to return to the auxiliary function mode display



This completes the manual adjustment of the motor current detection offset.

7.2.12 Write Protected Setting

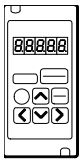
The write protect setting is used for preventing careless changes of the parameters. Parameters Pn□□□ and some of Fn□□□ become write protected by setting the parameter Fn010.

Password setting values are as follows:

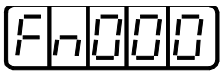
- "0000": Write enabled (Releases write prohibited mode.)
- "0001": Write prohibited (parameters become write protected at the next power ON.)

Follow the procedure below to set the write protection feature.

Using the Hand-held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

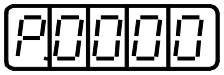


2. Select the parameter Fn010.

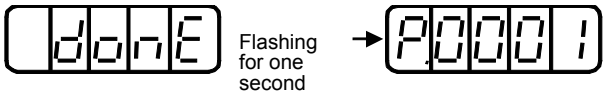
Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.

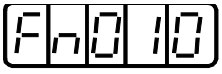
3. Press the **DATA/ENTER** key, and the display will be as shown below.



4. Input the value (0001) and press the **DSPL/SET** key. The display will change as shown below and the write protect will be established.

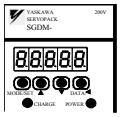


5. Press the **DATA/ENTER** key to return to the auxiliary function mode display.

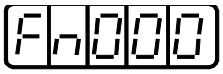


This completes the write protect setting procedure. The new setting will be valid after the next power OFF/ON cycle.

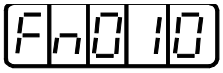
Using the Built-in Panel Operator



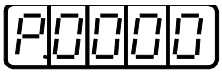
1. Press the **MODE/SET** key to select the auxiliary function mode.



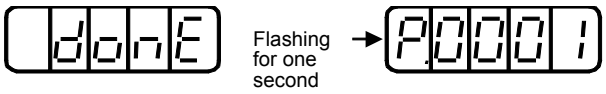
2. Press the **Up Arrow** ▽ or **Down Arrow** △ key to select the parameter Fn010.



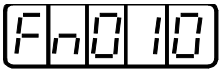
3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



4. Input the value (0001) and press the **MODE/SET** key. The display will change to one shown below and the write protect will be established.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



This completes the procedure for setting the write protect. The new setting password will be valid after the next power OFF/ON cycle.

7.2.13 Clearing the Option Unit Detection Alarm

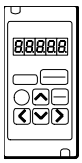
The alarm A.E7 (option unit detection failure) occurs the first time that the SGDH servo amplifier is turned ON after disconnecting an option board.

IMPORTANT

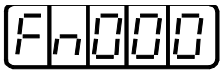
- **Initialize the parameter settings with the servo OFF.**
- **After performing the procedure, cycle the power to restore all the parameters to the default settings.**
- **Because the parameter has been set for the SGDH connected to an option board,**
  Be sure to adjust the setting or initialize the parameter value (Fn005 of the auxiliary function mode) to meet the current system needs.

Use the following procedure to initialize parameter settings.

Using the Hand-held Digital Operator



1. Press the **DSPL/SET** key to select the auxiliary function mode.

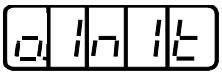


2. Select the parameter Fn014.

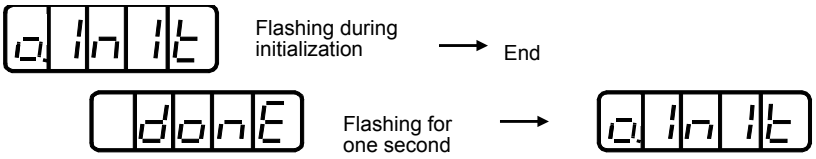
   Press the **Left Arrow** ⟨ or **Right Arrow** ⟨ key to select the digit.

Press the **Up Arrow** ⌄ or **Down Arrow** ⌃ key to change the value.

3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



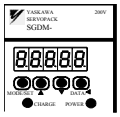
4. Press the **DSPL/SET** key, and the display will be as shown below. The parameters will be initialized.



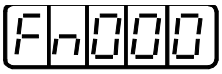
5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.

   This completes the initialization of parameter settings.

Using the Built-in Panel Operator



1. Press the **MODE/SET** key to select the auxiliary function mode.

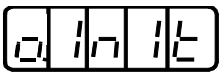


2. Select the parameter Fn014.

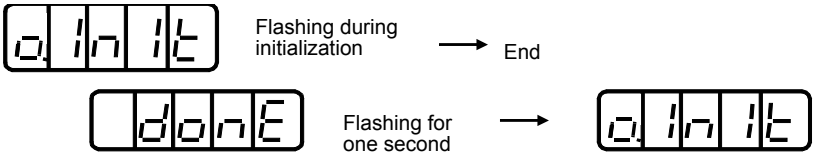
   Press the **Left Arrow** ◁ or **Right Arrow** ◁ key to select the digit.

Press the **Up Arrow** ▽ or **Down Arrow** △ key to change the value.

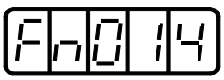
3. Press the **DATA/SHIFT** key for a minimum of one second, and the display will be as shown below.



4. Press the **MODE/SET** key, and the display will be as shown below. The parameters will be initialized.



5. Press the **DATA/SHIFT** key for a minimum of one second to return to the auxiliary function mode display.



   This completes the initialization of parameter settings.

8 Ratings and Characteristics

This chapter provides the ratings, torque-speed characteristics diagrams, and dimensional drawings of the Sigma II series servo drives.

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8.1.1 SGMAH Servomotors 8-2
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8.1 Servomotors: Ratings, Specifications, and Dimensional Drawings

This section describes ratings, specifications, and dimensional drawings of the servomotors. Refer to this section for selecting an appropriate servo drive.

8.1.1 SGMAH Servomotors

The following sections provide the ratings specifications, and dimensional drawings of the servomotors by model.

Ratings and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15µm or below
- Insulation Resistance: $500V_{DC}$, 10MΩ minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class B
- Withstand Voltage: $1500V_{ac}$ for one minute
- Enclosure: Totally enclosed, self-cooled, IP55 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMAH Standard Servomotor Ratings and Specifications

Voltage		200V						100V			
Servomotor Model SGMAH		A3A	A5A	01A	02A	04A	08A	A3B	A5B	01B	02B
Rated Output *1	kW	0.03	0.05	0.1	0.2	0.4	0.75	0.03	0.05	0.1	0.2
Rated Torque*1, *2	oz-in	13.52	22.5	45.1	90.2	180	338	13.52	22.5	45.1	90.2
	N-m	0.0955	0.159	0.318	0.637	1.27	2.39	0.0955	0.159	0.318	0.637
Instantaneous Peak Torque*1	oz-in	40.6	67.6	135.2	270	541	1010	40.6	67.6	135.2	270
	N-m	0.286	0.477	0.955	1.91	3.82	7.16	0.286	0.477	0.955	1.91
Rated Current*1	A_{rms}	0.44	0.64	0.91	2.1	2.8	4.4	0.66	0.95	2.4	3.0
Instantaneous Maximum Current*1	A_{rms}	1.3	2.0	2.8	6.5	8.5	13.4	2.0	2.9	7.2	9.0
Rated Speed*1	rpm	3000									
Maximum Speed*1	rpm	5000									
Torque Constant	(oz-in)/A_{rms}	33.7	38.0	53.6	46.2	70.6	83.6	22.2	25.8	20.7	33.2
	(N-m)/A_{rms}	0.238	0.268	0.378	0.327	0.498	0.590	0.157	0.182	0.146	0.234

*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at at an armature winding temperature of 100°C. Other values are quoted at 20°C. All values are typical.

*2 Rated torques are continuous allowable torque values at 40°C with a 10 × 10 × 0.25in (250 × 250 × 6mm) heat sink attached.

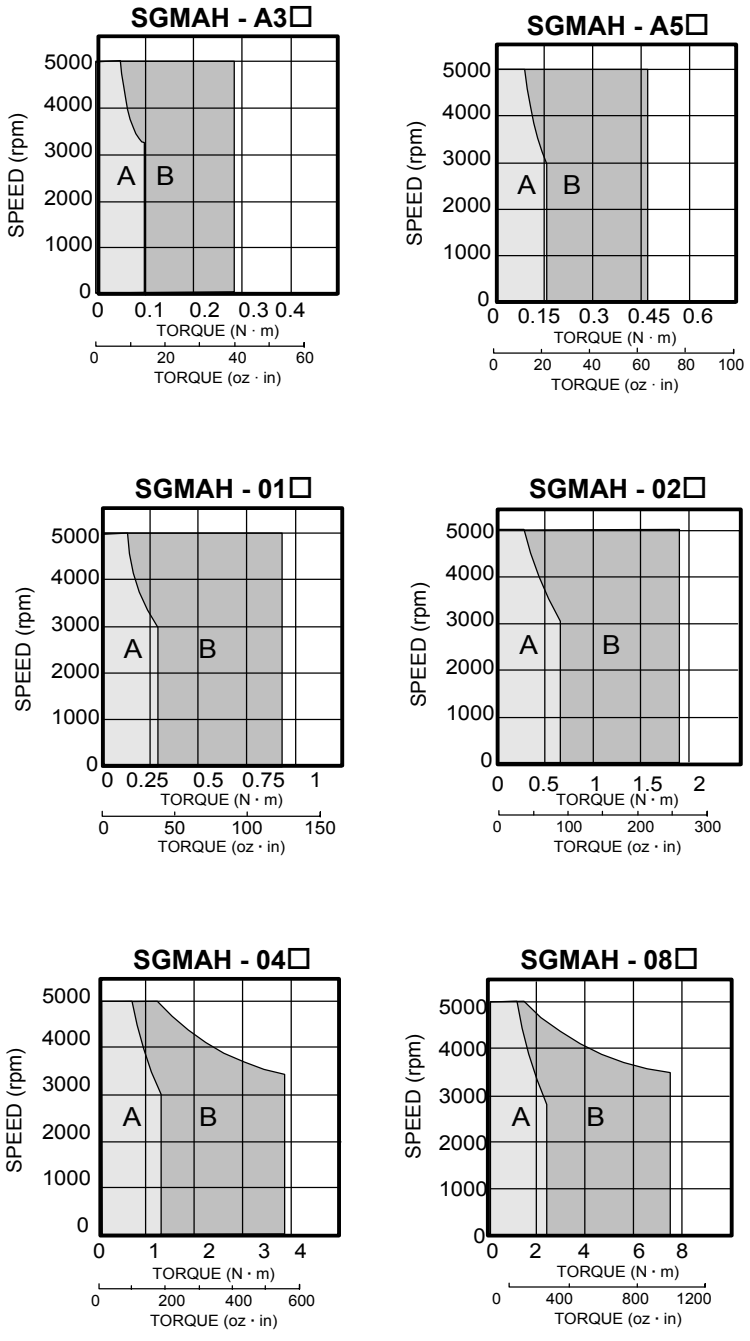
Voltage		200V						100V			
Servomotor Model SGMAH		A3A	A5A	01A	02A	04A	08A	A3B	A5B	01B	02B
Moment of Inertia	oz-in- s^2 x 10^{-3}	0.235	0.312	0.515	1.501	2.45	9.52	0.235	0.312	0.515	1.501
	kg-m^2 x 10^{-4}	0.0166	0.0220	0.0364	0.106	0.173	0.672	0.0166	0.0220	0.0364	0.106
Rated Power Rating*1	kW/s	5.49	11.5	27.8	38.2	93.7	84.8	5.49	11.5	27.8	38.2
Rated Angular Acceleration*1	rad/s^2	57500	72300	87400	60100	73600	35500	57500	72300	87400	60100
Inertia Time Constant	ms	1.4	0.88	0.53	0.39	0.25	0.26	1.4	0.85	0.61	0.41
Inductive Time Constant	ms	1.0	1.1	1.2	4.6	5.4	8.7	1.0	1.1	1.1	4.4

*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at at an armature winding temperature of 100°C. Other values are quoted at 20°C. All values are typical.

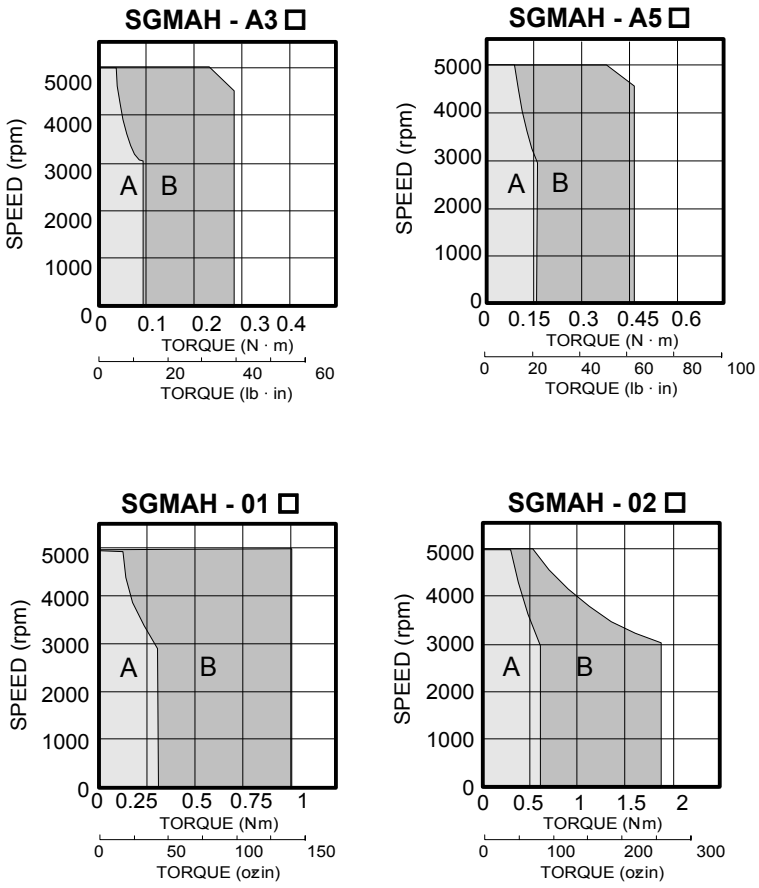
SGMAH Servomotor Motor Speed/Torque Characteristics

The torque-motor speed characteristics are shown below for SGMAH servomotors.

- **200V**



- **100V**

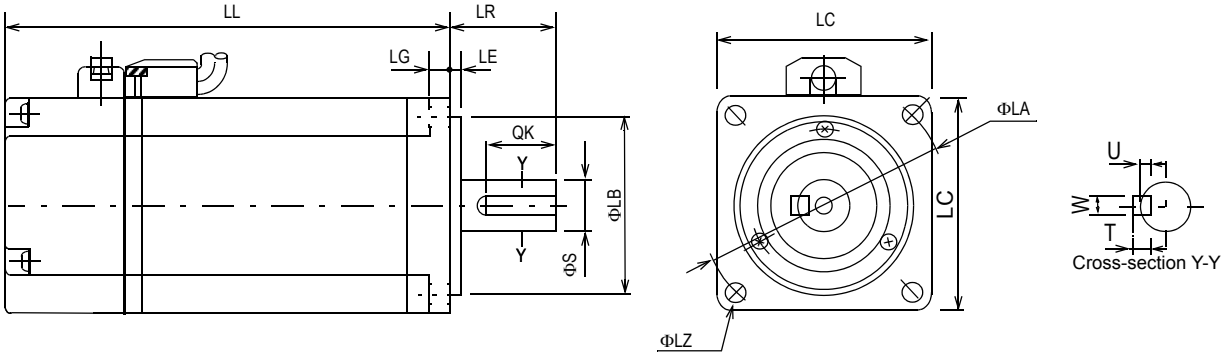


A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

SGMAH Dimensions in inches (mm)

Drawings that provide SGMAH servomotor (without brake) dimensions are shown below.



Model SGMAH-	LL	LR	LG	LC	LE	ΦLA	ΦLZ	ΦS	ΦLB	QK	U	W	T	Mass lb (kg)
A3A (B)	2.74 (69.5)	0.98 (25)	0.20 (5)	1.57 (40)	0.098 (2.5)	1.81 (46)	0.17 (4.3)	0.24 (6)	1.19 (30)	0.55 (14)	0.047 (0.12)	0.79 (2)	0.79 (2)	0.3 (0.661)
A5A (B)	3.03 (77.0)													0.4 (0.882)
01A (B)	3.72 (94.5)							0.32 (8)			0.7 (1.8)	0.7 (1.8)	0.12 (3)	0.5 (1.10)
02A (B)	3.80 (96.5)	1.18 (30)	0.24 (6)	2.36 (60)	0.12 (3)	2.76 (70)	0.22 (5.5)	0.56 (14)	1.98 (50)	0.79 (20)	0.12 (3)	0.2 (5)	0.2 (5)	1.1 (2.43)
04A	4.90 (124.5)													1.7 (3.75)
08A	5.71 (145)	1.57 (40)	0.31 (8)	3.15 (80)		3.54 (90)	0.28 (7)	0.64 (16)	2.78 (70)	1.18 (30)				3.4 (7.50)

Specified Tolerances				
Dimension	ΦS		ΦLB	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	0.24	+0.0000-0.0004	1.19	+0.0000 -0.0008
	0.31		1.98	+0.0000 -0.0010
	0.56		2.78	+0.0000 -0.0012
	0.64			
mm	6	+0.000 -0.009	30	+0.000 -0.021
	8		50	+0.000 -0.025
	14	+0.000 -0.011	70	+0.000 -0.030
	16			

8.1.2 SGMPH Servomotors

Ratings and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15μm or below
- Insulation Resistance: $500V_{DC}$, 10MΩ minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class B
- Withstand Voltage: $1500V_{ac}$ for one minute
- Enclosure: Totally enclosed, self-cooled, IP67 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMPH Standard Servomotor Ratings and Specifications

Voltage		200V					100V	
Servomotor Model SGMPH-		01A	02A	04A	08A	15A	01B	02B
Rated Output *1	kW	0.1	0.2	0.4	0.75	1.5	0.1	0.2
Rated Torque*1, *2	oz-in	45.1	90.2	180	338	676	45.1	90.2
	N-m	0.318	0.637	1.27	2.39	4.77	0.318	0.637
Instantaneous Peak Torque*1	oz-in	135	270	541	1010	2030	135.2	270
	N-m	0.955	1.91	3.82	7.16	14.3	0.955	1.91
Rated Current*1	A_{rms}	0.89	2.0	2.6	4.1	7.5	2.2	2.7
Instantaneous Max. Current*1	A_{rms}	2.8	6.0	8.0	13.9	23.0	7.1	8.4
Rated Speed*1	rpm	3000						
Max. Speed*1	rpm	5000						
Torque Constant	$(oz\text{-}in)/A_{rms}$	55.6	49.4	75.8	91.0	97.4	22.8	36.5
	$(N\text{-}m)/A_{rms}$	0.392	0.349	0.535	0.641	0.687	0.160	0.258
Moment of Inertia	$oz\text{-}in\text{-}s^2 \times 10^{-3}$	0.695	2.73	4.69	29.7	56.9	0.695	2.73
	$kg\text{-}m^2 \times 10^{-4}$	0.0491	0.193	0.331	2.10	4.02	0.0491	0.193
Rated Power Rating*1	kW/s	20.6	21.0	49.0	27.1	56.7	20.6	21.0
Rated Angular Acceleration*1	rad/s^2	64800	33000	38500	11400	11900	64800	33000
Inertia Time Constant	ms	0.53	0.54	0.36	0.66	0.46	0.56	0.64
Inductive Time Constant	ms	3.7	7.4	8.6	18	22	3.6	6.3

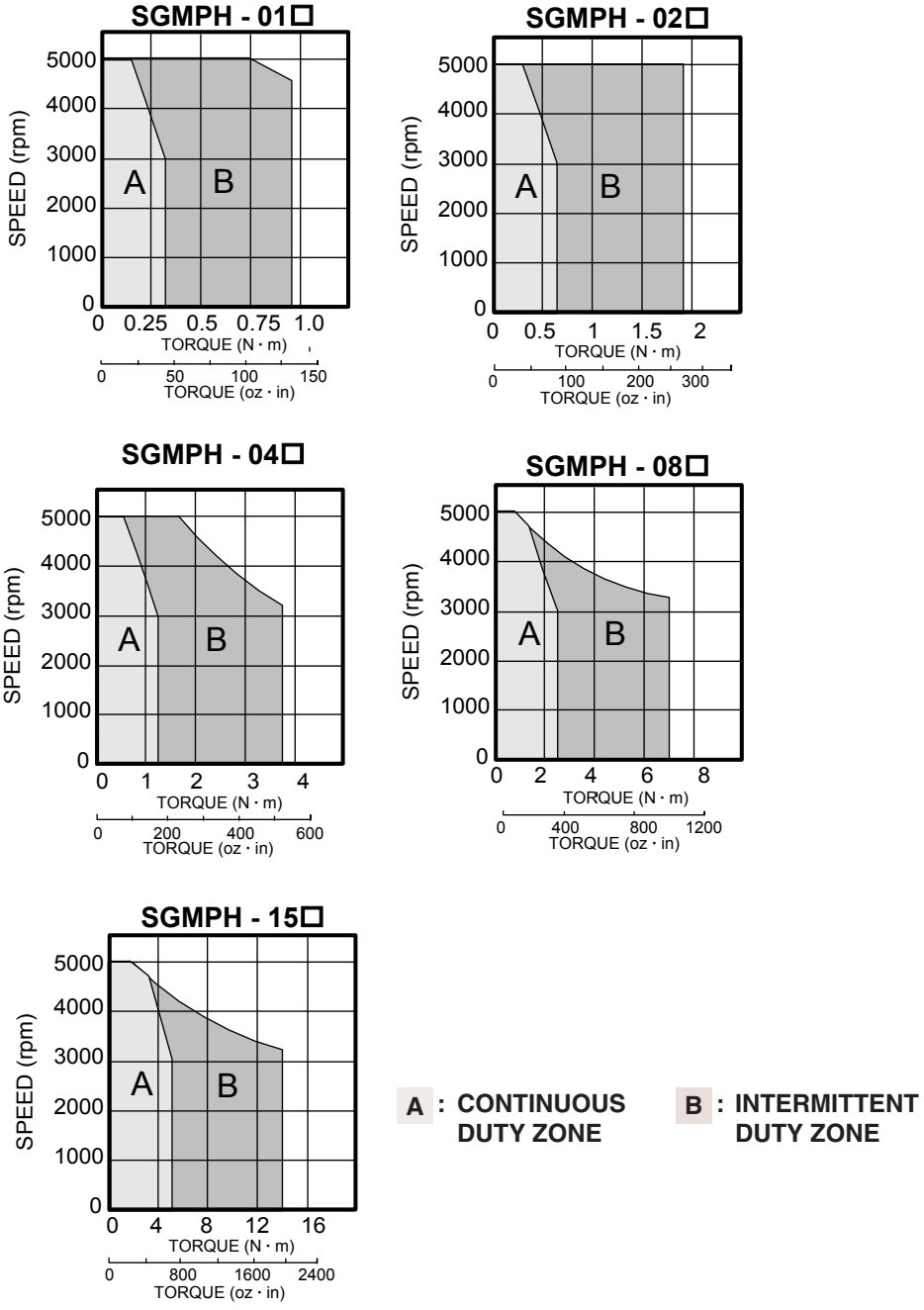
*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at an armature winding temperature of 100°C. Other values are quoted at 20°C. All values are typical.

*2 Rated torques are continuous allowable torque values at 40°C with a 10 × 10 × 0.25in (250 × 250 × 6mm) heat sink attached.
Heat sink dimensions:
10 × 10 × 0.25in (250 × 250 × 6mm): 0.1to 0.4kW
12 × 12 × 0.5in (300 × 300 × 12mm): 0.75 to 1.5 kW

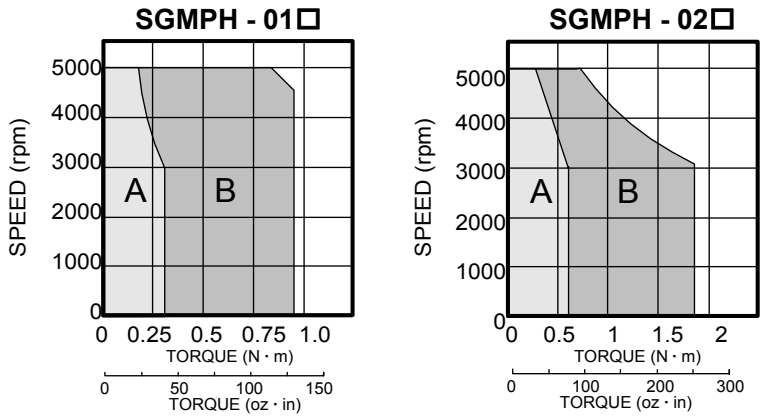
SGMPH Servomotor Motor Speed/Torque Characteristics

The torque-motor speed characteristics are shown below for SGMPH servomotors.

- **200V**



- **100V**

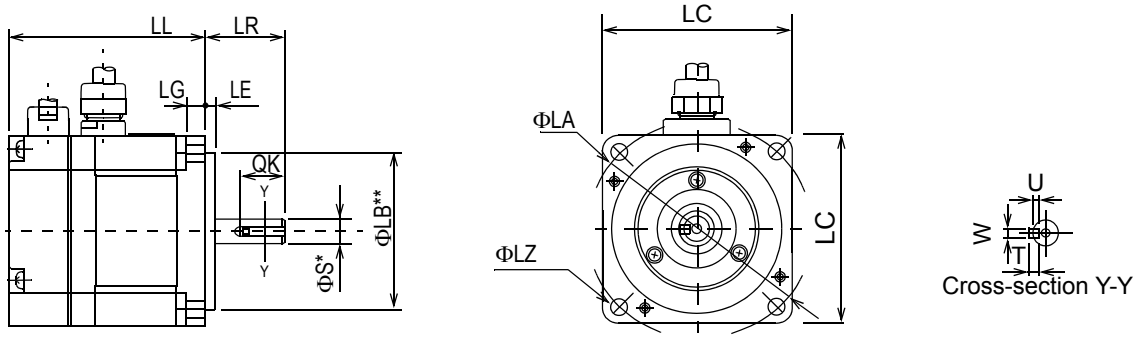


A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

SGMPH Dimensions in inches (mm)

Drawings that provide SGMPH servomotor (without brake) dimensions are shown below.



Model SGMPH-	LL	LR	LG	LC	LE	ΦLA	ΦLZ	ΦS	ΦLB	QK	U	W	T	Mass lb (kg)
01A (B)	2.44 (62)	0.98 (25)	0.24 (6)	2.36 (60)	0.12 (3)	2.76 (70)	0.22 (5.5)	0.32 (8)	1.98 (50)	0.55 (14)	0.071 (1.8)	0.12 (3)	0.12 (3)	1.54 (0.7)
02A (B)	2.64 (67.0)		0.31 (8)	3.15 (80)		3.54 (90)	0.28 (7)	0.56 (14)	2.76 (70)	0.64 (16)	0.12 (3)	0.2 (5)	0.2 (5)	3.09 (1.4)
04A (B)	3.43 (87)													4.63 (2.1)
08A (B)	3.410 (86.5)	1.18 (30)	0.39 (10)	4.72 (120)	0.14 (3.5)	5.71 (145)	0.39 (10)	0.64 (16)	4.37 (110)	0.87 (22)				9.26 (4.2)
15A	4.51 (114.5)							0.75 (19)			0.14 (3.5)	0.24 (6)	0.24 (6)	14.6 (6.6)

Specified Tolerances				
Dimension	ΦS		ΦLB	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	0.32	+0.0000-0.0004	1.98	+0.0000 -0.0010
	0.56		2.78	+0.0000 -0.0012
	0.64		4.37	+0.0000 -0.0014
	0.75	+0.0000-0.0005		
mm	8	+0.000 -0.009	50	+0.000 -0.025
	14	+0.000 -0.011	70	+0.000 -0.030
	16		110	+0.000 -0.035
	19	+0.000 -0.013		

8.1.3 SGMGH Servomotors

Rating and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15μm or below
- Insulation Resistance: $500V_{DC}$, 10MΩ minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class F
- Withstand Voltage:
  $1500V_{ac}$ for one minute (200V specification)
  $1800V_{ac}$ for one minute (400V specification)
- Enclosure: Totally enclosed, self-cooled, IP67 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMGH Standard Servomotor Ratings and Specifications

Voltage		200V									
Servomotor Model SGMGH-		05A□A	09A□A	13A□A	20A□A	30A□A	44A□A	55A□A	75A□A	1AA□A	1EA□A
Rated Output *1	kW	0.45	0.85	1.3	1.8	2.9	4.4	5.5	7.5	11	15
Rated Torque *1	lb-in	25	48	74	102	165	252	310	425	620	845
	N-m	2.84	5.39	8.34	11.5	18.6	28.4	35.0	48.0	70.0	95.4
Instantaneous Peak Torque *1	lb-in	79	122	207	254	404	630	775	1050	1550	1984
	N-m	8.92	13.8	23.3	28.7	45.1	71.1	87.6	119	175	224
Rated Current *1	A_{rms}	3.8	7.1	10.7	16.7	23.8	32.8	42.1	54.7	58.6	78.0
Instantaneous Max. Current *1	A_{rms}	11	17	28	42	56	84	110	130	140	170
Rated Speed *1	rpm	1500									
Maximum Speed *1	rpm	3000								2000	
Torque Constant	(lb-in)/A_{rms}	7.26	7.35	7.43	6.46	7.35	8.05	7.79	8.23	11.1	11.7
	(N-m)/A_{rms}	0.82	0.83	0.84	0.73	0.83	0.91	0.88	0.93	1.25	1.32
Moment of Inertia	lb-in-s^2 x 10^{-3}	6.41	12.3	18.2	28.1	40.7	59.8	78.8	111	250	279
	kg-m^2 x 10^{-4}	7.24	13.9	20.5	31.7	46.0	67.5	89.0	125	281	315
Rated Power Rating *1	kW/s	11.2	20.9	33.8	41.5	75.3	120	137	184	174	289
Rated Angular Acceleration *1	rad/s^2	3930	3880	4060	3620	4050	4210	3930	3850	2490	3030
Inertia Time Constant	ms	5.0	3.1	2.8	2.1	1.9	1.3	1.3	1.1	1.2	0.98
Inductive Time Constant	ms	5.1	5.3	6.3	12.5	12.5	15.7	16.4	18.4	22.6	27.2

*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at an armature winding temperature of 20°C.

Note: These characteristics have been calculated with the following heat sinks attached for cooling:

Heat sink dimensions

15.75 × 15.75 × 0.79in (400 × 400 × 20mm): 05A□A to 13A□A servomotors
05D□A to 13D□A servomotors

21.65 × 21.65 × 1.18in (550 × 550 × 30mm): 20A□A to 75A□A servomotors
20D□A to 30D□A servomotors

SGMGH Standard Servomotor Ratings and Specifications

Voltage		400V									
Servomotor Model SGMGH-		05D□A	09D□A	13D□A	20D□A	30D□A	44D□A	55D□A	75D□A	1AD□A	1ED□A
Rated Output *1	kW	0.45	0.85	1.3	1.8	2.9	4.4	5.5	7.5	11.0	15.0
Rated Torque *1	lb-in	25	48	74	102	165	252	310	425	620	845
	N-m	2.84	5.39	8.34	11.5	18.6	28.4	35.0	48.0	70.0	95.4
Instantaneous Peak Torque *1	lb-in	79	122	207	254	404	630	804	1091	1550	1960
	N-m	8.92	13.8	23.3	28.7	45.1	71.1	90.7	123	175	221
Rated Curren *1	A_{rms}	1.9	3.5	5.4	8.4	11.9	16.5	20.8	25.4	28.1	37.2
Instantaneous Max. Current *1	A_{rms}	5.5	8.5	14	20	28	40.5	55	65	70	85
Rated Speed *1	rpm	1500									
Maximum Speed *1	rpm	3000								2000	
Torque Constant	$(lb\text{-}in)/A_{rms}$	14.5	14.6	14.9	12.6	14.7	16.1	15.4	17.7	22.7	23.4
	$(N\text{-}m)/A_{rms}$	1.64	1.65	1.68	1.46	1.66	1.82	1.74	2.0	2.56	2.64
Moment of Inertia	$lb\text{-}in\text{-}s^2 \times 10^{-3}$	6.42	12.3	18.2	28.0	40.7	59.8	78.8	111	250	279
	$kg\text{-}m^2 \times 10^{-4}$	7.24	13.9	20.5	31.7	46.0	67.54	89.0	125	281	315
Rated Power Rating *1	kW/s	11.2	20.9	33.8	41.5	75.3	120	137	184	174	289
Rated Angular Acceleration *1	rad/s^2	3930	3880	4060	3620	4050	4210	3930	3850	2490	3030
Inertia Time Constant	ms	5.6	3.1	2.9	2.4	2.0	1.4	1.4	1.1	1.1	1.0
Inductive Time Constant	ms	4.5	5.3	6.1	11.1	12.3	15.2	14.4	17.6	22.9	26.2

*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at an armature winding temperature of 20°C.

Note: These characteristics have been calculated with the following heat sinks attached for cooling:

Heat sink dimensions

15.75 × 15.75 × 0.79in (400 × 400 × 20mm): 05A□A to 13A□A servomotors
05D□A to 13D□A servomotors

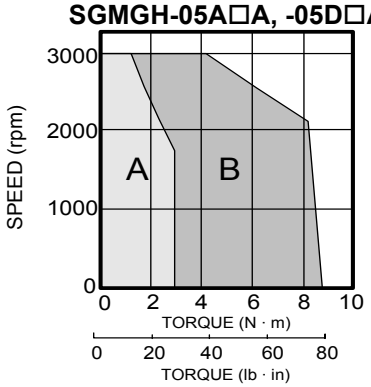
21.65 × 21.65 × 1.18in (550 × 550 × 30mm): 20A□A to 75A□A servomotors
20D□A to 30D□A servomotors

SGMGH Servomotor Motor Speed/Torque Characteristics

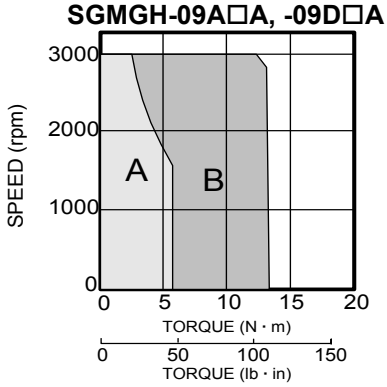
The following sections provide the torque-motor speed characteristics of the SGMGH servomotors at 1500rpm

200/400V

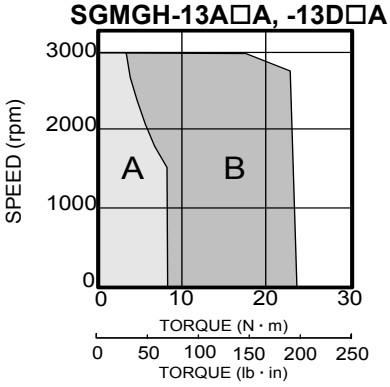
SGMGH-05A□A, -05D□A



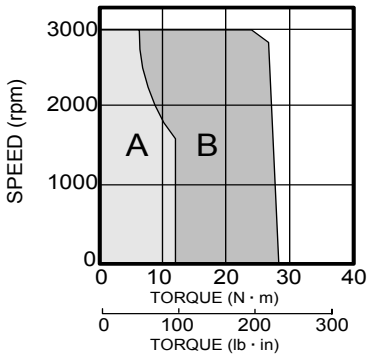
SGMGH-09A□A, -09D□A



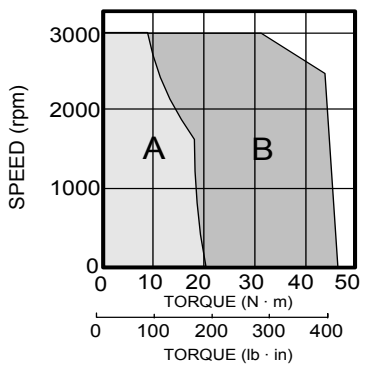
SGMGH-13A□A, -13D□A



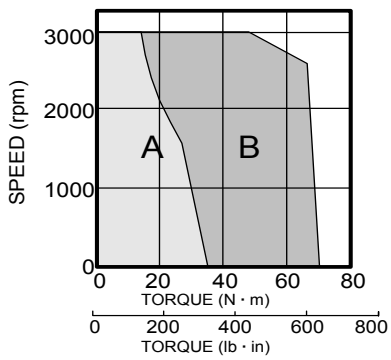
SGMGH-20A□A, -20D□A



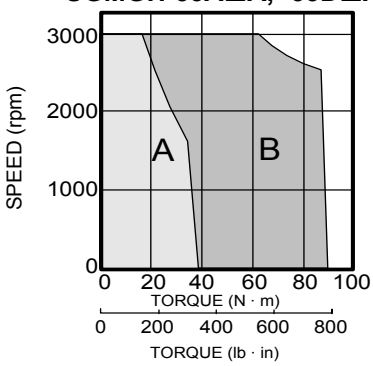
SGMGH-30A□A, -30D□A



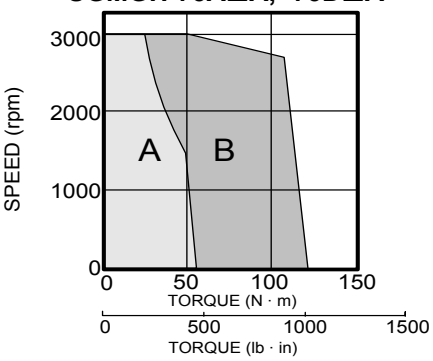
SGMGH-44A□A, -44D□A



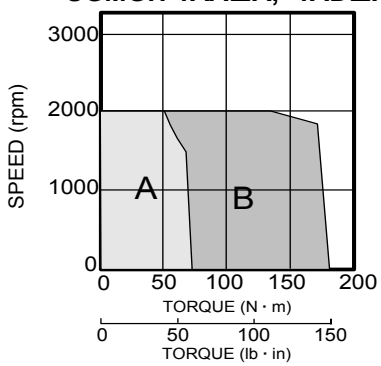
SGMGH-55A□A, -55D□A



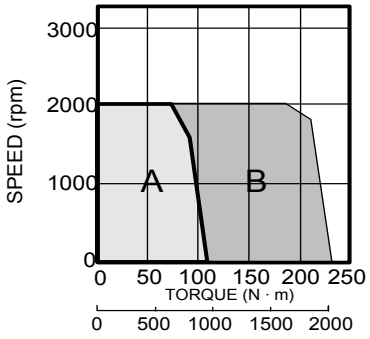
SGMGH-75A□A, -75D□A



SGMGH-1AA□A, -1AD□A



SGMGH-1EA□A, 1ED□A

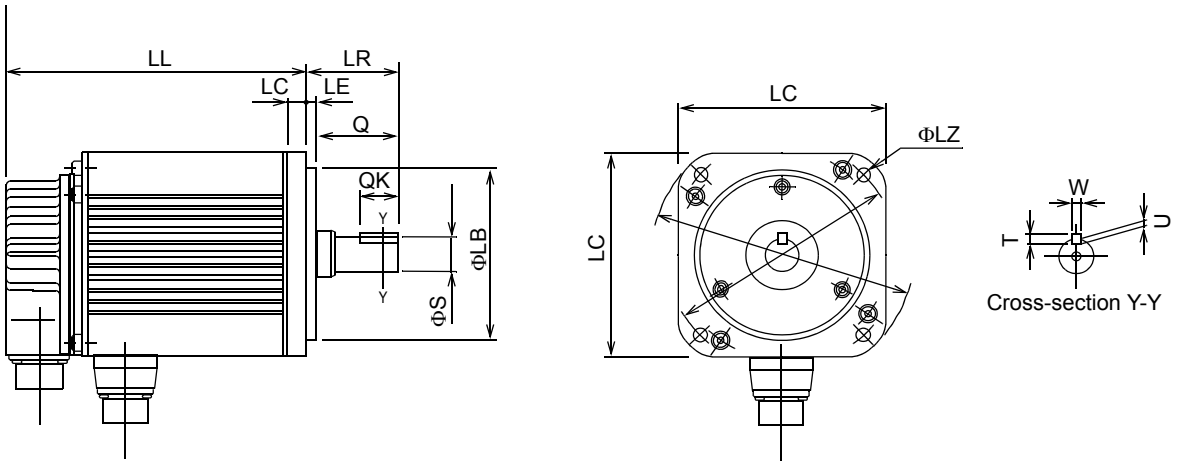


A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

SGMGH Dimensions in inches (mm)

Drawings that provide (1500rpm) SGMGH servomotor (without brake) dimensions are shown below.



Model SGMGH-	LL	LR	LG	LC	LE	ΦLA	ΦLZ	ΦS	ΦLB	Q	QK	U	W	T	Mass lb (kg)
05A□A 05D□A	5.43 (138)	2.28 (58)	0.47 (12)	5.12 (130)	0.24 (6)	5.71 (145)	0.35 (9)	0.75 (19)	4.33 (110)	1.57 (40)	0.98 (25)	0.12 (3)	0.20 (5)	0.20 (5)	12.1 (5.5)
09A□A 09D□A	6.34 (161)														16.8 (7.6)
13A□A 13D□A	7.28 (185)							0.87 (22)				0.14 (3.5)			21.2 (9.6)
20A□A 20D□A	6.54 (166)	3.11 (79)	0.71 (18)	7.09 (180)	0.13 (3.2)	7.87 (200)	0.53 (13.5)	1.38 (35)	4.50 (114.3)	2.99 (76)	2.36 (60)	0.20 (5)	0.39 (10)	0.31 (8)	30.9 (14)
30A□A 30D□A	7.56 (192)														39.7 (18)
44A□A 44D□A	8.9 (226)														50.7 (23)
55A□A 55D□A	10.2 (260)	4.45 (113)						1.65 (42)		4.33 (110)	3.54 (90)		0.47 (12)		66.1 (30)
75A□A 75D□A	13.1 (334)														88.2 (40)
1AA□A 1AD□A	13.3 (338)	4.57 (116)		8.66 (220)	0.16 (4)	9.25 (235)			7.87 (200)						127 (57.5)
1EA□A 1ED□A	18.0 (457)		0.79 (20)					2.16 (55)				0.24 (6)	0.63 (16)	0.39 (10)	190 (86)

Specified Tolerances				
Dimension	ΦLB		ΦS	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	4.33	+0.0000-0.0014	0.75	+0.0000-0.0005
			0.87	
	4.50	+0.0000-0.0010	1.38	+0.0004-0.0000
			1.65	+0.0000-0.0006

Specified Tolerances				
Dimension	ΦLB		ΦS	
Unit	Diameter	Tolerance	Diameter	Tolerance
mm	110	+0.000 -0.035	19	+0.000 -0.013
			22	
	114.3	+0.000 -0.025	35	+0.01 -0.00
			42	+0.000 -0.016

8.1.4 SGMSH Servomotors

Rating and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15μm or below
- Insulation Resistance: $500V_{DC}$, 10MΩ minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class F
- Withstand Voltage:
  $1500V_{ac}$ for one minute (200V specification)
  $1800V_{ac}$ for one minute (400V specification)
- Enclosure: Totally enclosed, self-cooled, IP67 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMSH Standard Servomotor Ratings and Specifications

Voltage		200V					
Servomotor Model SGMSH-		10A□A	15A□A	20A□A	30A□A	40A□A	50A□A
Rated Output *1	kW	1.0	1.5	2.0	3.0	4.0	5.0
Rated Torque*1	lb-in	28.2	43	56.4	87	112	140
	N-m	3.18	4.9	6.36	9.8	12.6	15.8
Instantaneous Peak Torque*1	lb-in	84.4	130	169	260	336	422
	N-m	9.54	14.7	19.1	29.4	37.8	47.6
Rated Current*1	A_{rms}	5.7	9.7	12.7	18.8	25.4	28.6
Instantaneous Maximum Current*1	A_{rms}	17	28	42	56	77	84
Rated Speed*1	rpm	3000					
Maximum Speed*1	rpm	5000					
Torque Constant	(lb-in)/A_{rms}	5.63	4.97	4.81	5.07	4.69	5.31
	(N-m)/A_{rms}	0.636	0.561	0.544	0.573	0.53	0.60
Moment of Inertia	lb-in-s^2 x 10^{-3}	1.54	2.19	2.82	6.20	8.50	10.90
	kg-m^2 x 10^{-4}	1.74	2.47	3.19	7.00	9.60	12.3
Rated Power Rating*1	kW/s	57.9	97.2	127	137	166	202
Rated Angular Acceleration*1	rad/s^2	18250	19840	19970	14000	13160	12780
Inertia Time Constant	ms	0.87	0.74	0.62	0.74	0.65	0.59
Inductive Time Constant	ms	7.1	7.7	8.3	13.0	14.1	14.7

*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at an armature winding temperature of 20°C.

Note: These characteristics have been calculated with the following aluminum heat sinks attached for cooling:
Heat sink dimensions
12 × 12 × 0.5in. (300 × 300 × 12mm): 10A□A to 20A□A servomotors
18 × 18 × 0.8in. (400 × 400 × 20mm): 30A□A to50A□A servomotors

Voltage		400V					
Servomotor Model SGMSH-		10D□A	15D□A	20D□A	30D□A	40D□A	50D□A
Rated Output *1	kW	1.0	1.5	2.0	3.0	4.0	5.0
Rated Torque*1	lb-in	28.2	43	56.4	87	112	140
	N-m	3.18	4.9	6.36	9.8	12.6	15.8
Instantaneous Peak Torque*1	lb-in	84.4	130	169	260	336	422
	N-m	9.54	14.7	19.1	29.4	37.8	47.6
Rated Current*1	A_{rms}	2.8	4.7	6.2	8.9	12.5	13.8
Instantaneous Maximum Current*1	A_{rms}	8.5	14	19.5	28	38	42
Rated Speed*1	rpm	3000					
Maximum Speed*1	rpm	5000					
Torque Constant	(lb-in)/A_{rms}	11.2	10.2	9.9	10.5	9.49	11.0
	(N-m)/A_{rms}	1.74	2.47	1.12	1.19	1.07	1.24
Moment of Inertia	lb-in-s^2 x 10^{-3}	1.54	2.19	2.82	6.20	8.50	10.90
	kg-m^2 x 10^{-4}	1.74	2.47	3.19	7.0	9.60	12.3
Rated Power Rating*1	kW/s	57.9	97.2	127	137	166	202
Rated Angular Acceleration*1	rad/s^2	18250	19840	19970	14000	13160	12780
Inertia Time Constant	ms	0.97	0.8	0.66	0.76	0.62	0.55
Inductive Time Constant	ms	6.3	6.8	7.3	16.3	14.4	15.2

*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at an armature winding temperature of 20°C.

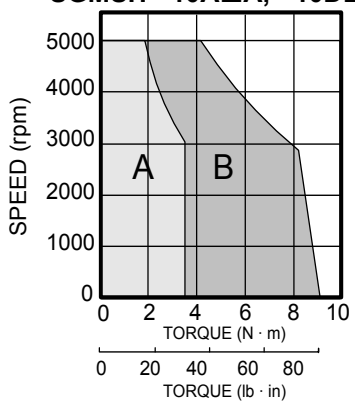
Note: These characteristics have been calculated with the following aluminum heat sinks attached for cooling:
Heat sink dimensions
12 × 12 × 0.5in (300 × 300 × 12mm): 10D□A to 20D□A servomotors
18 × 18 × 0.8in (400 × 400 × 20mm): 30D□A servomotors

SGMSH Servomotor Motor Speed/Torque Characteristics

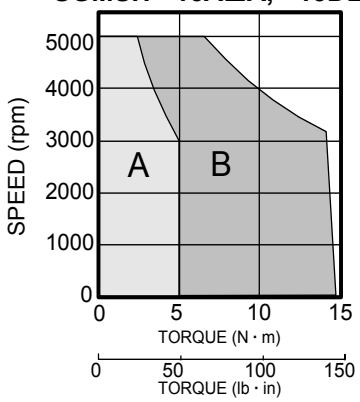
The following sections provide the torque-motor speed characteristics of the SGMSH servomotors.

200/400V

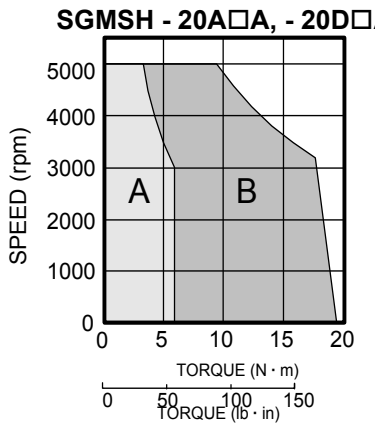
SGMSH - 10A□A, - 10D□A



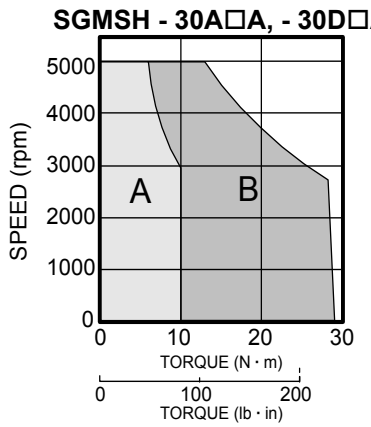
SGMSH - 15A□A, - 15D□A



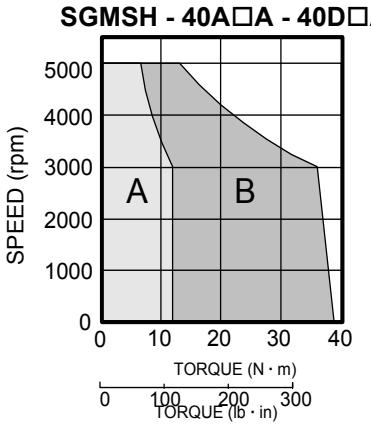
SGMSH - 20A□A, - 20D□A



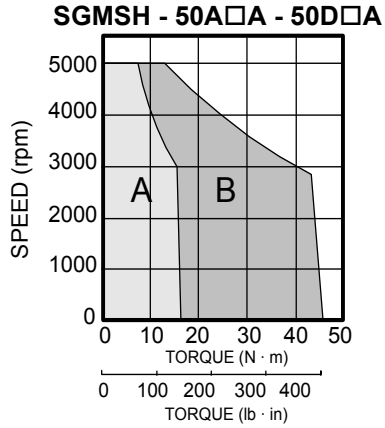
SGMSH - 30A□A, - 30D□A



SGMSH - 40A□A - 40D□A



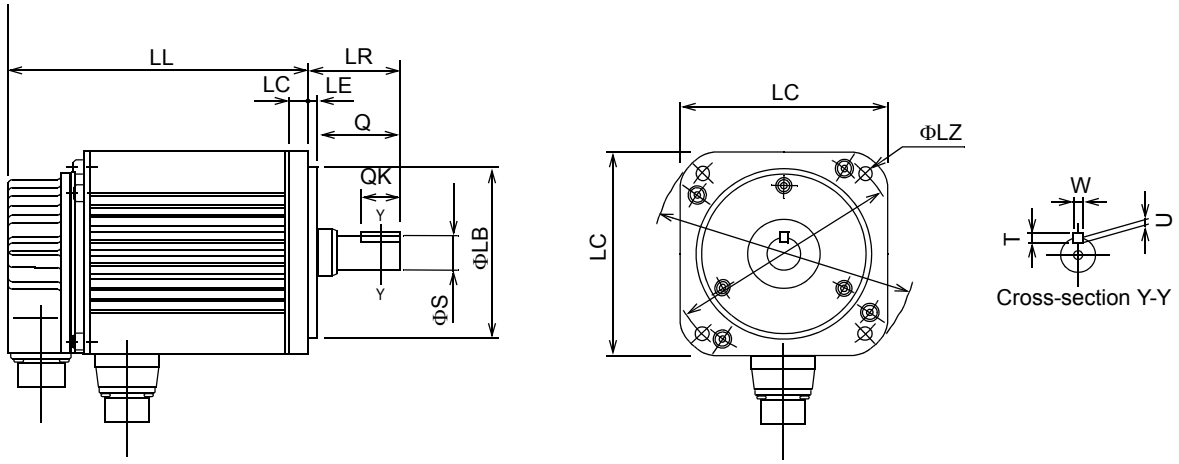
SGMSH - 50A□A - 50D□A



A : CONTINUOUS DUTY ZONE **B : INTERMITTENT DUTY ZONE**

SGMSH Dimensions in inches (mm)

Drawings that provide SGMSH servomotor dimensions (without brake) are shown below.



Model SGMSH-	LL	LR	LG	LC	LE	ΦLA	ΦLZ	ΦS	ΦLB	Q	QK	U	W	T	Mass lb (kg)
10A□A 10D□A	5.87 (149)	1.77 (45)	0.39 (10)	3.94 (100)	0.12 (3)	4.53 (115)	0.28 (7)	0.94 (24)	3.74 (95)	1.57 (40)	1.26 (32)	0.16 (4)	0.31 (8)	0.28 (7)	10.14 (4.6)
15A□A 15D□A	6.89 (175)														12.79 (5.8)
20A□A 20D□A	7.80 (198)														15.43 (7.0)
30A□A 30D□A	7.83 (199)	2.48 (63)	0.47 (12)	5.12 (130)	0.24 (6)	5.71 (145)	0.35 (9)	1.10 (28)	4.33 (110)	2.17 (55)	1.96 (50)				24.25 (11)
40A□A 40D□A	9.29 (236)														30.86 (14)
50A□A 50D□A	10.9 (276)														37.48 (17)

Specified Tolerances				
Dimension	ΦLB		ΦS	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	3.74 4.33	+0.0000-0.0014	0.94 1.10	+0.0000-0.0005
mm	95 110	+0.000 -0.035	24 28	+0.000 -0.013

8.1.5 SGMUH Servomotors

Rating and Specifications for Standard Servomotors

- Time Rating: Continuous
- Vibration Class: 15μm or below
- Insulation Resistance: $500V_{DC}$, 10MΩ minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange method
- Insulation Class: Class F
- Withstand Voltage: $1,800V_{ac}$ for one minute
- Enclosure: Totally enclosed, self-cooled, IP67 (except for through-sections of the shaft)
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive

SGMUH Standard Servomotor Ratings and Specifications

Servomotor Model SGMUH-		10D□A	15D□A	30D□A
Rated Output *1	kW	1.0	1.5	3.0
Rated Torque*1	lb-in	14.1	21.7	43.5
	N-m	1.59	2.45	4.9
Instantaneous Peak Torque*1	lb-in	57.6	97.5	190
	N-m	6.5	11	21.5
Rated Current*1	A_{rms}	2.7	4.1	8.1
Instantaneous Maximum Current*1	A_{rms}	8.5	47	28
Rated Speed*1	rpm	6000		
Maximum Speed*1	rpm	6000		
Torque Constant	$(lb\text{-}in)/A_{rms}$	7.2	7.4	7.2
	$(N\text{-}m)/A_{rms}$	0.81	0.83	0.81
Moment of Inertia	$lb\text{-}in\text{-}s^2 \times 10^{-3}$	1.54	2.19	6.2
	$kg\text{-}m^2 \times 10^{-4}$	1.74	2.47	7.00
Rated Power Rating*1	kW/s	14.5	24.3	34.3
Rated Angular Acceleration*1	rad/s^2	9130	9910	7000
Inertia Time Constant	ms	0.87	0.70	0.72
Inductive Time Constant	ms	7.1	7.7	17.3

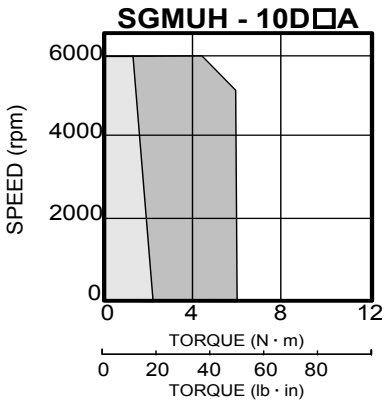
*1 These specifications and torque-motor speed characteristics are quoted in combination with an SGDH servo amplifier operating at an armature winding temperature of 20°C.

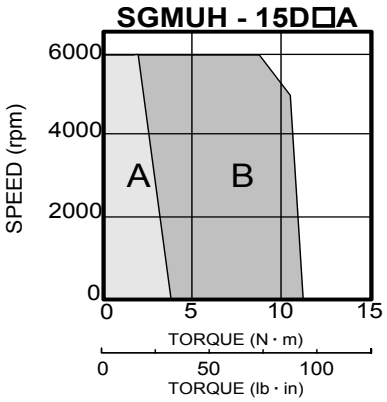
Note: These characteristics have been calculated with the following aluminum heat sinks attached for cooling:
Heat sink dimensions
12 × 12 × 0.5in (300 × 300 × 12mm): 10D□A to 20D□A
18 × 18 × 0.8in (400 × 400 × 20mm): 30D□A

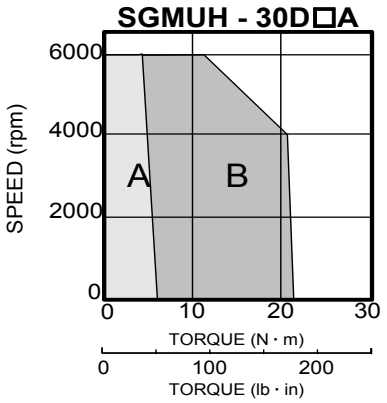
SGMUH Servomotor Motor Speed/Torque Characteristics

The following sections provide the torque-motor speed characteristics of the SGMUH servomotors.

400V





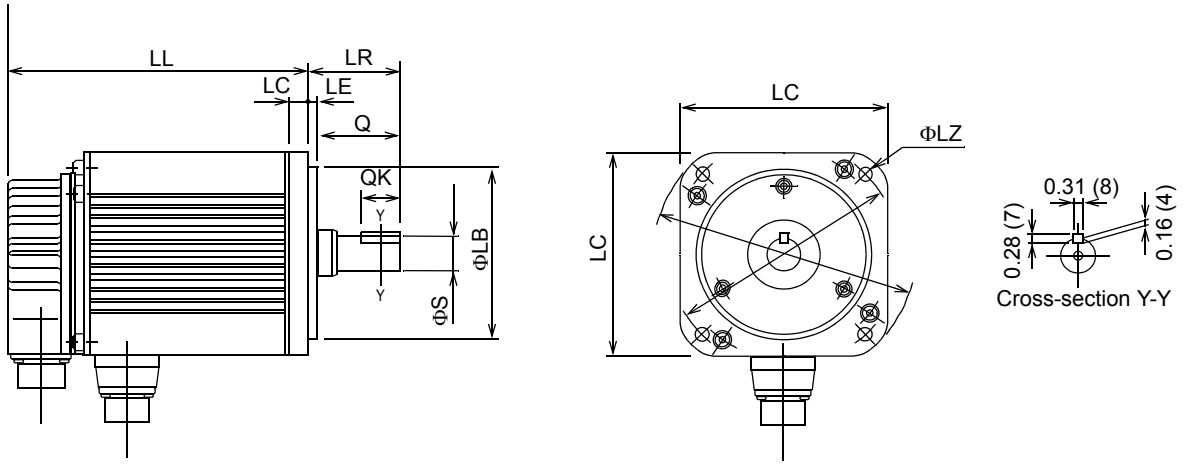


A : CONTINUOUS DUTY ZONE

B : INTERMITTENT DUTY ZONE

SGMUH Dimensions in inches (mm)

Drawings that provide SGMUH servomotor dimensions are shown below.



Model SGMUH-	LL	LR	LG	LC	LE	ΦLA	ΦLZ	ΦS	ΦLB	Q	QK	Mass lb (kg)
10D□A	5.87 (149)	1.77 (45)	0.39 (10)	4.57 (116)	0.14 (3.5)	5.12 (130)	0.35 (9)	0.94 (24)	4.33 (110)	1.57 (40)	1.26 (32)	10.14 (4.6)
15D□A	6.89 (175)											12.78 (5.8)
30D□A	7.83 (199)	2.36 (60)	0.47 (12)	6.10 (155)		6.50 (165)	0.43 (11)	1.10 (28)	5.12 (130)	2.17 (55)	1.96 (50)	24.25 (11)

Specified Tolerances				
Dimension	ΦLB		ΦS	
Unit	Diameter	Tolerance	Diameter	Tolerance
in	4.33	+0.0005-0.0004	0.94	+0.0000-0.0005
	5.12		1.10	
mm	110	+0.013 -0.009	24	+0.000 -0.013
	130	+0.014 -0.011	28	

8.1.6 SGMBH Servomotors

- Time Rating: Continuous
- Vibration Class: V15
- Insulation Resistance: $500V_{DC}$, 10MΩ minimum
- Ambient Temperature: 0 to 40°C
- Excitation: Permanent magnet
- Mounting: Flange mounting or Foot Mounted (55kW only)
- Thermal Class: F
- Withstand Voltage:$1800V_{ac}$ for one minute
- Enclosure: Externally fan cooled type, IP44
- Ambient Humidity: 20% to 80% (with no condensation)
- Drive Method: Direct drive
- Thermal Protection: Built-In

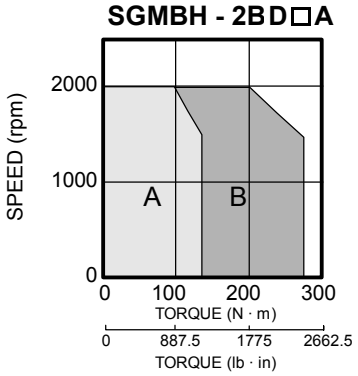
SGMBH Standard Servomotor Ratings and Specifications

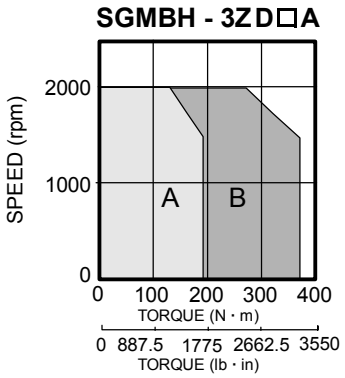
Servomotor Model SGMBH-		2BD□A	3ZD□A	3GD□A	4ED□A	5ED□A
Rated Output	kW	22	30	37	45	55
Rated Torque	N-m	140	191	236	286	350
Instantaneous Peak Torque	N-m	280	382	471	572	700
Rated Current	A_{rms}	58	80	100	127	150
Instantaneous Maximum Current	A_{rms}	120	170	210	260	310
Rated Speed	RPM	1500				
Instantaneous Maximum Speed	RPM	2000				
Torque Constant	$N\text{-}m/A_{rms}$	2.50	2.39	2.46	2.37	2.40
Moment of Inertia	$kg\text{-}m^2 \times 10^{-4}$	592	773	1390	1510	1970
Rated Power Rating	kW/s	331	472	401	542	622
Rated Angular Acceleration	rad/s^2	2360	2470	1700	1890	1780
Inertia Time Constant	ms	2.6	2.3	3.6	2.8	2.7
Conductive Time Constant	ms	53	57	67	72	78

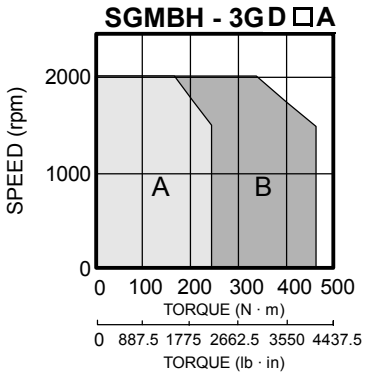
SGMBH Servomotor Motor Speed/Torque Characteristics

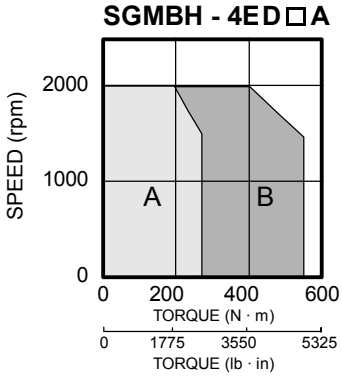
The following sections provide the torque-motor speed characteristics of the SGMUH servomotors.

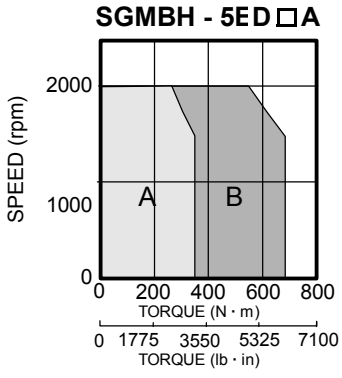
SGMBH 400V Servomotors









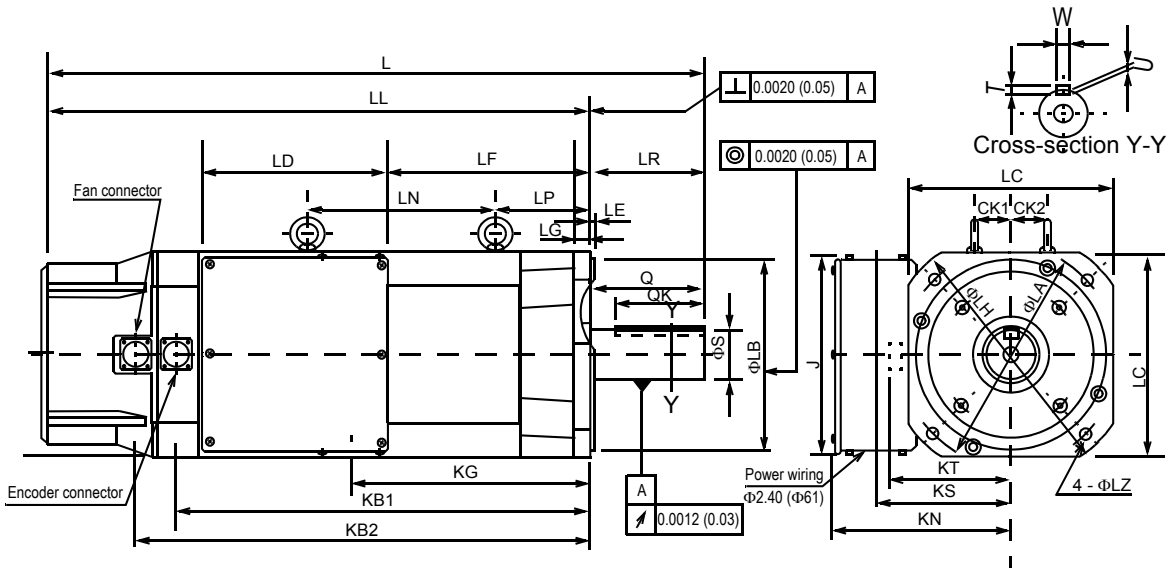


A : CONTINUOUS DUTY ZONE **B : INTERMITTENT DUTY ZONE**

SGMBH Dimensions in inches (mm)

(1) 17 Bit Incremental/Absolute Encoder

Drawings that provide SGMBH servomotor dimensions are shown below.



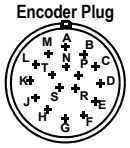
Type SGMBH-	Motor Body Dimensions																Flange Dimensions							Shaft End Dimension					
	L	LL	LR	LD	LF	LN	LP	KB1	KB2	KG	KN	KS	KT	CK1	CK2	J	ΦLA	ΦLB**	LC	LE	LG	ΦLH	ΦLZ	ΦS*	Q	QK	W****	T***	U
2BD□A61	29.13 (740)	23.62 (600)	5.51 (140)	9.06 (230)	6.97 (177)	6.30 (160)	4.57 (116)	17.17 (436)	19.06 (484)	8.82 (224)	8.66 (220)	6.42 (163)	5.87 (149)	1.77 (45)	1.77 (45)	9.84 (250)	10.43 (265)	9.06 (230)	9.84 (250)	0.20 (5)	0.79 (20)	11.81 (300)	0.53 (13.5)	2.36 (60)	5.51 (140)	4.33 (110)	0.71 (18)	0.43 (11)	0.28 (7)
3ZD□A61	31.91 (810)	26.38 (670)			9.65 (245)	9.06 (230)		19.86 (504)	21.75 (552)	11.50 (292)																			

Type SGMBH-	Approximate Mass lb (kg)	Allowable Radial Load lb (N)	Allowable Thrust Load lb (N)
2BD□A61	264.5 (120)	1323 (5880)	485 (2156)
3ZD□A61	308.7 (140)	1410 (6272)	

Specified Tolerances								
Dimension	*ΦS		**ΦLB		***T		****W	
Unit	Diameter	Tolerance	Diameter	Tolerance	Length	Tolerance	Length	Tolerance
in	2.362	+0.00118 -0.00043	9.055	+0.0000 -0.00181	0.433	+0.0000 -0.00043	0.709	+0.0000 -0.00169
mm	60	+0.030 -0.011	230	+0.000 -0.046	11	+0.000 -0.1103	18	+0.000 -0.043

Note: 1. Dimensions are the same when using either incremental or absolute encoders.
2. Tolerances on the dimensions of flange type LB, of shaft extensions S, and of keyway width and depth are based on JIS (Japanese Industrial Standard) B0401 "Limits and Fits for Engineering."

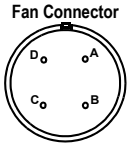
Encoder Plug



Connector Wiring on the Encoders			
A	—	K	—
B	—	L	—
C	Data +	M	—
D	Data –	N	—
E	—	P	—
F	—	R	—
G	0V	S	Battery – (Note*)
H	+5V$_{dc}$	T	Battery + (Note*)
J	FG (Frame Ground)	*Note: Used with an absolute encoder only.	

Non-Environmental Mating Connector:
MS3108B20-29S (L Type)
MS3106B20-29S (Straight Type)
Cable Clamp: MS3057-12A

Fan Connector

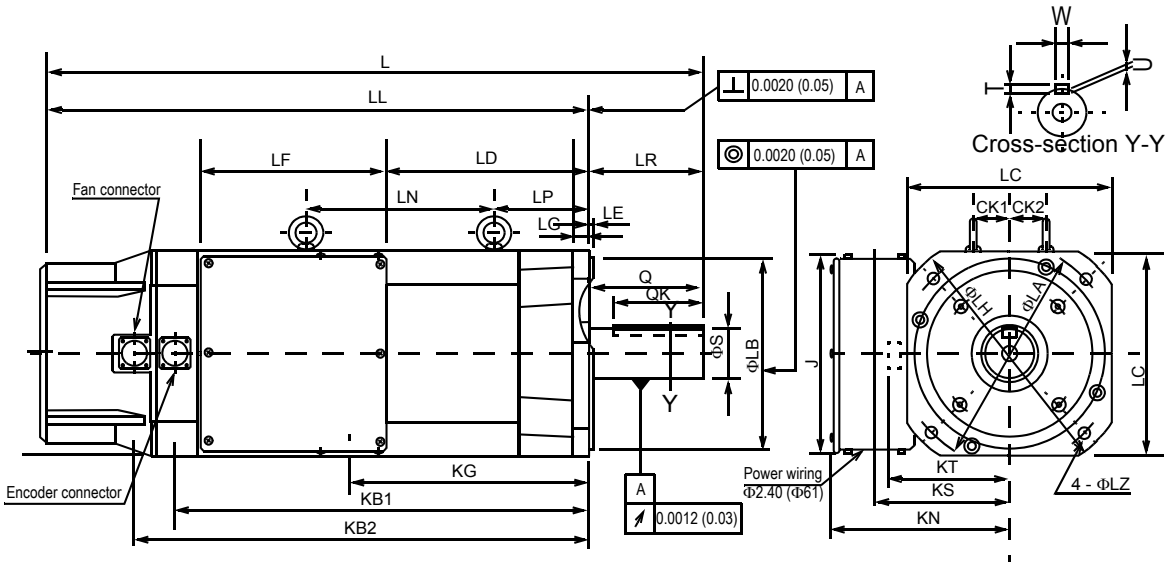


Fan Connector	
A	U Phase
B	V Phase
C	W Phase
D	—

Receptacle: CE05-2A18-10PD-B
Non-environmental mating connector: MS3108B18-10S (L-Type)
Cable Clamp: MS3057-10A

Power Wiring Terminal Box		
Terminal	Connection	Screw Size
U, V, W	Motor	M10
⏚	Ground	

(2) 17 Bit Incremental/Absolute Encoder, with Brake



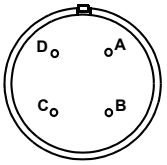
Type SGMBH-	Motor Body Dimensions																Flange Dimensions							Shaft End Dimension					
	L	LL	LR	LD	LF	LN	LP	KB1	KB2	KG	KN	KS	KT	CK1	CK2	J	ΦLA	ΦLB**	LC	LE	LG	ΦLH	ΦLZ	ΦS*	Q	QK	W****	T***	U
2B D□A6C	33.86 (860)	28.35 (720)	5.51 (140)	6.97 (177)	9.06 (230)	15.47 (393)	4.57 (116)	21.89 (556)	23.78 (604)	8.82 (224)	8.66 (220)	6.42 (163)	5.87 (149)	1.77 (45)	0.98 (25)	9.84 (250)	10.43 (265)	9.06 (230)	9.84 (250)	0.20 (5)	0.79 (20)	11.81 (300)	0.53 (13.5)	2.36 (60)	5.51 (140)	4.33 (110)	0.71 (18)	0.43 (11)	0.28 (7)
3Z D□A6C	36.64 (930)	31.13 (790)		9.65 (245)		18.16 (461)		24.57 (624)	26.46 (672)	11.5 (292)																			

Type SGMBH-	Approximate Mass lb (kg)	Allowable Radial Load lb (N)	Allowable Thrust Load lb (N)
2BD□A6C	331 (150)	1323 (5880)	485 (2156)
3ZAD□A6C	375 (170)	1410 (6272)	

Specified Tolerances								
Dimension	*ΦS		**ΦLB		***T		****W	
Unit	Diameter	Tolerance	Diameter	Tolerance	Length	Tolerance	Length	Tolerance
in	2.362	+0.00118 -0.00043	9.055	+0.0000 -0.00181	0.433	+0.0000 -0.00043	0.709	+0.0000 -0.00169
mm	60	+0.030 -0.011	230	+0.000 -0.046	11	+0.000 -0.1103	18	+0.000 -0.043

Note: 1. Dimensions are the same when using either incremental or absolute encoders.
2. Tolerances on the dimensions of flange type LB, of shaft extensions S, and of keyway width and depth are based on JIS (Japanese Industrial Standard) B0401 "Limits and Fits for Engineering."

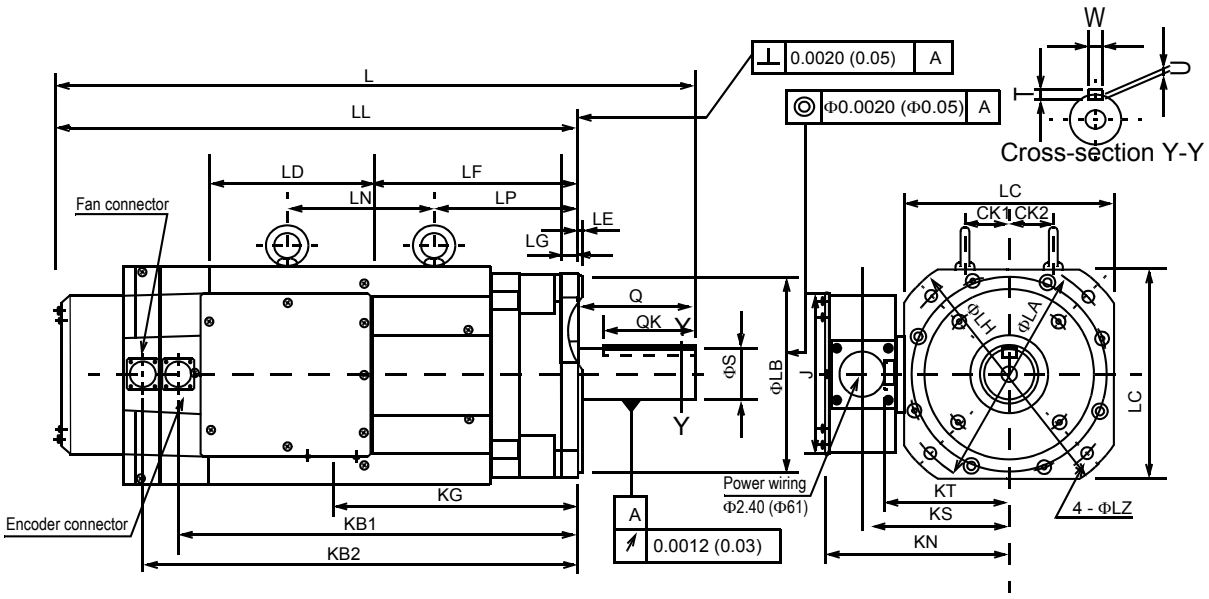
Power WiringTerminal Box		
Terminal	Connection	Screw Size
U, V, W	Motor	M10
⏚	Ground	
A, B	Brake	M4



Fan Connector	
A	U Phase
B	V Phase
C	W Phase
D	Ground Terminal

Receptacle: CE05-2A18-10PD-B
Non-environmental mating connector: MS3108B18-10S (L-Type)
Cable Clamp: MS3057-10A

(3) 17 Bit Incremental/Absolute Encoder



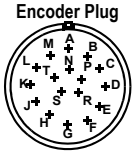
Type SGMBH-	Motor Body Dimensions															Flange Dimensions							Shaft End Dimension					
	L	LL	LD	LF	LN	LP	KB1	KB2	KG	KN	KS	KT	CK1	CK2	J	ΦLA	ΦLB*	LC	LE	LG	ΦLH	ΦLZ	ΦS*	Q	QK	W*** *	T***	U
3GD□A61	32.0 (814)	26.5 (674)	9.29 (236)	9.45 (240)	5.91 (150)	7.87 (200)	20.1 (510)	22.0 (558)	11.6 (295)	8.66 (220)	7.91 (201)	6.85 (174)	2.36 (60)	2.36 (60)	8.66 (220)	11.8 (300)	9.84 (250)	11.8 (300)	0.20 (5)	1.38 (35)	13.8 (350)	0.69 (17.5)	2.76 (70)	5.51 (140)	4.33 (110)	0.79 (20)	0.47 (12)	0.29 (7.5)
4ED□A61	33.7 (855)	28.1 (715)		11.1 (281)	7.87 (200)		21.7 (551)	23.6 (599)	13..2 (336)																			

Type SGMBH-	Approximate Mass lb (kg)	Allowable Radial Load lb (N)	Allowable Thrust Load lb (N)
3GD□A61	507.1 (230)	1674 (7448)	485 (2156)
4ED□A61	551.1 (250)	1762 (7840)	

Specified Tolerances								
Dimension	*ΦS		**ΦLB		***T		****W	
Unit	Diameter	Tolerance	Diameter	Tolerance	Length	Tolerance	Length	Tolerance
in	2.76	+0.0012 -0.004	9.84	+0.0000 -0.0018	0.47	+0.0000 -0.00433	0.79	+0.0000 -0.00204
mm	70	+0.030 +0.011	250	+0.000 -0.046	12	+0.000 -0.110	20	+0.000 -0.052

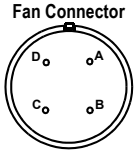
Note: 1. Dimensions are the same when using either incremental or absolute encoders.
2. Tolerances on the dimensions of flange type LB, of shaft extensions S, and of keyway width and depth are based on JIS (Japanese Industrial Standard) B0401 "Limits and Fits for Engineering."

Encoder Plug



Connector Wiring on the Encoders			
A	—	K	—
B	—	L	—
C	Data +	M	—
D	Data –	N	—
E	—	P	—
F	—	R	—
G	0V	S	Battery – (Note*)
H	$+5V_{dc}$	T	Battery + (Note*)
J	FG (Frame Ground)	*Note: Used with an absolute encoder only.	

Fan Connector

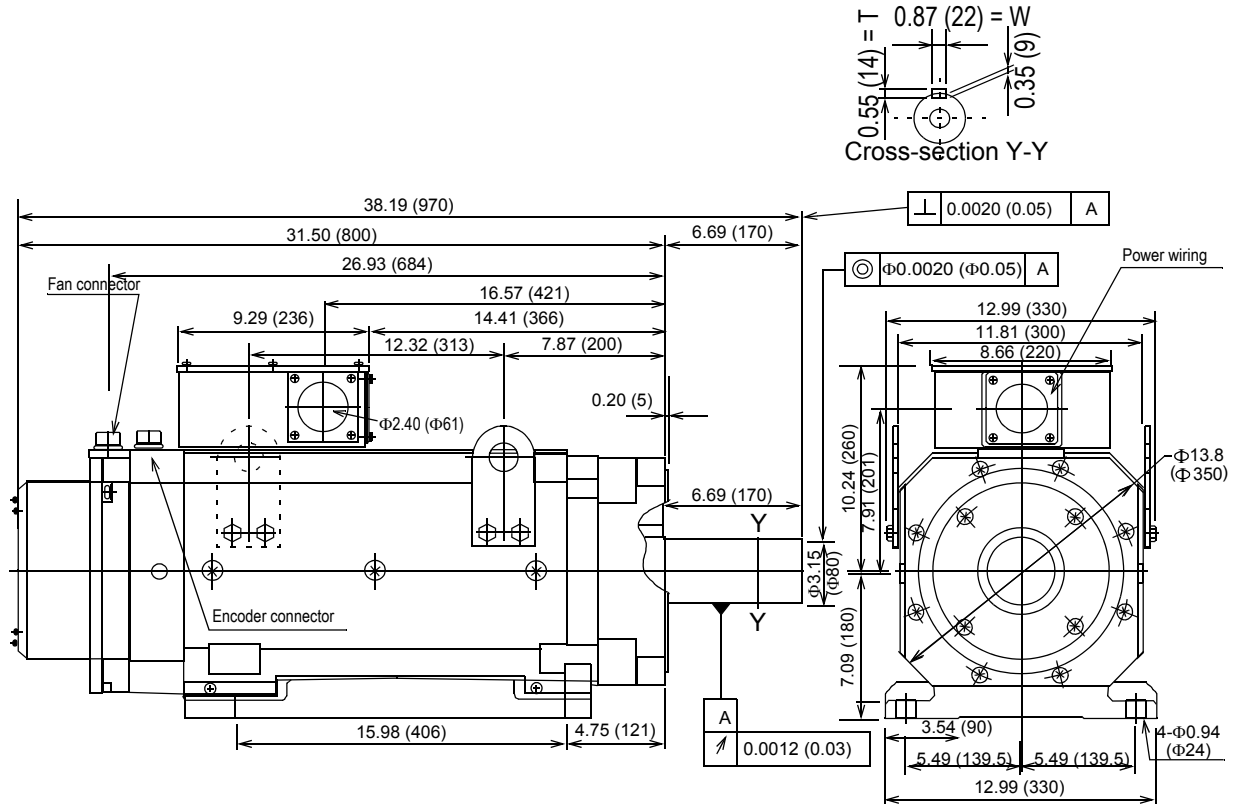


Fan Connector	
A	U Phase
B	V Phase
C	W Phase
D	—

Receptacle: CE05-2A18-10PD-B
Non-environmental mating connector: MS3108B18-10S (L-Type)

Power Wiring Terminal Box		
Terminal	Connection	Screw Size
U, V, W	Motor	M10
⏚	Ground	

(4) 17 Bit Incremental/Absolute Encoder

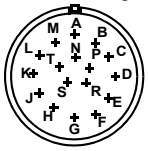


	Approximate Mass lb (kg)	Allowable Radial Load lb (N)	Allowable Thrust Load lb (N)
5ED?AL1	772 (350)	1895 (8428)	485 (2156)

Note: 1. Dimensions are the same when using either incremental or absolute encoders.
2. Tolerances on the dimensions of flange type LB, of shaft extensions S, and of keyway width and depth are based on JIS (Japanese Industrial Standard) B0401 "Limits and Fits for Engineering."

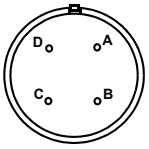
Specified Tolerances				
Dimension	*T		*W	
Unit	Length	Tolerance	Length	Tolerance
in	0.55	+0.0000 -0.00433	0.87	+0.0000 -0.00204
mm	14	+0.000 -0.110	22	+0.000 -0.052

Encoder Plug



Connector Wiring on the Encoders			
A	—	K	—
B	—	L	—
C	Data +	M	—
D	Data –	N	—
E	—	P	—
F	—	R	—
G	0V	S	Battery – (Note*)
H	+5V$_{dc}$	T	Battery + (Note*)
J	FG (Frame Ground)	*Note: Used with an absolute encoder only.	

Fan Connector



Fan Connector	
A	U Phase
B	V Phase
C	W Phase
D	—

Receptacle: CE05-2A18-10PD-B
Non-environmental mating connector: MS3108B18-10S (L-Type)

Power Wiring Terminal Box		
Terminal	Connection	Screw Size
U, V, W	Motor	M10
⏚	Ground	

8.1.7 SGMCS Direct Drive Motors

This section presents the SGMCS direct drive motor ratings and specifications.

Servomotor Model SGMCS-			02B	05B	07B	04C	10C	14C
Ratings and Specifications	Rated Output	W	42	105	147	84	209	293
	Rated Torque	N-m	2.0	5.0	7.0	4.0	10.0	14.0
	Instantaneous Peak Torque	N-m	6.0	15.0	21.0	12.0	30.0	42.0
	Rated Current	A	1.9	1.8	1.4	2.1	2.0	2.0
	Instantaneous Max. Current	A	5.4	5.2	4.2	6.1	5.8	6.1
	Rated Speed	rpm	200			200		
	Max. Speed	rpm	500			500	400	300
	Rotor Moment of Inertia	N-m × 10^{-4}	25.0	61.0	99.0	67.0	167.0	266.0
Construction	Outside Diameter	mm	135			175		
	Length	mm	51	80	120	59	80	120
	Mass	kg	5.0	6.2	8.6	7.2	10.2	14.2
	Protective Construction	–	IP42					
	Vibration Resistance	m/s^2	49					
Encoder	Output Form	–	Serial data transmission					
	Number of Pulses per Rotation	P/R	1,048,576 (20-bit)					

Servomotor Model SGMCS-			08D	17D	25D	16E	35E
Ratings and Specifications	Rated Output	W	168	356	393	335	550
	Rated Torque	N-m	8.0	17.0	25.0	16.0	35.0
	Instantaneous Peak Torque	N-m	24.0	51.0	75.0	48.0	105.0
	Rated Current	A	2.1	2.3	2.7	3.5	3.6
	Instantaneous Max. Current	A	5.9	6.7	7.9	9.8	10.2
	Rated Speed	rpm	200		150	200	150
	Max. Speed	rpm	500	350	250	500	250
	Rotor Moment of Inertia	N-m × 10^{-4}	338.0	621.0	909	1080	1490

Servomotor Model SGMCS-			08D	17D	25D	16E	35E
Construction	Outside Diameter	mm	230			290	
	Length	mm	64	100	150	76	100
	Mass	kg	14.0	22.0	29.7	26.0	34.0
	Protective Construction	–	IP42				
	Vibration Resistance	m/s^2	49				
Encoder	Output Form	–	Serial data transmission				
	Number of Pulses per Revolution	P/R	1,048,576 (20-bit)				

Servomotor Model SGMCS-			SGMCS-□□□					
			45M	80M	1AM	80N	1EN	2ZN
Ratings and Specifications	Rated Output	W	707	1260	1730	1260	2360	3140
	Rated Torque	N-m	45	80	110	80	150	200
	Instantaneous Peak Torque	N-m	135	240	330	240	450	600
	Rated Current	A	5.8	9.74	13.4	9.35	17.4	18.9
	Instantaneous Max. Current	A	17	28	42	28	56	56
	Rated Speed	rpm	150					
	Max. Speed	rpm	300				250	
	Rotor Moment of Inertia	$N\text{-}m \times 10^{-4}$	388	627	865	1360	2470	3060
Construction	Outside Diameter	mm	280			360		
	Length	mm	157.5	207.5	257.5	167.5	217.5	267.5
	Mass	kg	38	45	51	50	68	86
	Protective Construction	–	IP44					
	Vibration Resistance	m/s^2	24.5					
Encoder	Output Form	–	Serial data transmission					
	Number of Pulses per Rotation	P/R	1,048,576(20-bit)					

8.2 Specifications

8.2.1 Combined Specifications

The following table provides specifications of the SGDH servo amplifiers and SGMAH, SGMPH, SGMGH, and SGMSH combinations.

■ Specifications for Servo Amplifier and Single/Three-phase, 200V Servomotor Combinations

Voltage			Single-phase 200V							Three-phase 200V			
Servo Amplifier Model SGDH-			A3AE	A5AE	01AE	02AE	04AE	08AE-S	15AE-S	05AE	08AE	10AE	15AE
SGMAH Series	Applicable Servomotor	Model SGMAH-	A3A	A5A	01A	02A	04A	08A	—	—	08A	—	—
		Capacity (kW)	0.03	0.05	0.1	0.2	0.4	0.75	—	—	0.75	—	—
		Motor Speed (rpm)	Rated 3000/maximum 5000										
	Applicable Encoder		Standard: 13-bit incremental encoder										
	Continuous Output Current A_{rms}		0.44	0.64	0.91	2.1	2.8	4.4	—	—	4.4	—	—
	Maximum Output Current A_{rms}		1.3	2.0	2.8	6.5	8.5	13.4	—	—	13.4	—	—
	Allowable Regenerative Energy[*1] (Joules)		18.5		37.1			—	—	—			
	Allowable Regenerative Frequency[*2] (times/min)		—					—	—	—	89	—	

[*1] Allowable regenerative energy is the value with an AC input power supply voltage of $200V_{rms}$. This may vary with power supply fluctuation.

[*2] Allowable regenerative frequency is the number of times the servomotor is allowed to accelerate and decelerate through a 0rpm → maximum motor speed → 0rpm cycle in a minute.

Voltage			Single-phase 200V							Three-phase 200V			
Servo Amplifier Model SGDH-			A3AE	A5AE	01AE	02AE	04AE	08AE-S	15AE-S	—	08AE	—	15AE
SGMPH Series	Applicable Servomotor	Model SGMPH-	—	—	01A	02A	04A	08A	15A	—	08A	—	15A
		Capacity (kW)	—	—	0.1	0.2	0.4	0.75	1.5	—	0.75	—	1.5
		Motor Speed (rpm)	Rated 3000/maximum 5000										
	Applicable Encoder		Standard: 13-bit incremental encoder										
	Continuous Output Current A_{rms}		—	—	0.89	2.0	2.6	4.1	7.5	—	4.1	—	7.5
	Maximum Output Current A_{rms}		—	—	2.8	6.0	8.0	13.9	23.0	—	13.9	—	23.0
	Allowable Regenerative Energy* (Joules)		—		37.1			—		—			
	Allowable Regenerative Frequency** (times/min)		—							—	29	—	17

Voltage			Three-phase 200V									
Servo Amplifier Model SGDH-			05AE	08AE	10AE	15AE	20AE	30AE.	50AE	60AE	75AE	1AAE	1EAE
SGMGH Series	Applicable Servomotor	Model SGMGH-	05A□A	—	09A□A	13A□A	20A□A	30A□A	44A□A	55A□A	75A□A	1AA□A	1EA□A
		Capacity (kW)	0.45	—	0.85	1.3	1.8	2.9	4.4	5.5	7.5	11	15
		Motor Speed (rpm)	Rated 1500/maximum 3000										
	Applicable Encoder		Standard: 17-bit incremental encoder										
	Continuous Output Current A_{rms}		3.8	—	7.1	10.7	16.7	23.8	32.8	42.1	54.7	58.6	78.0
	Maximum Output Current A_{rms}		11	—	17	28	42	56	84	110	130	140	170
	Allowable Regenerative Frequency*2 (Times/min)		34	—	13	10	12	8	11	26**	36**		

*1 Allowable regenerative energy is the value with an AC input power supply voltage of $200V_{rms}$. This may vary with power supply fluctuation.

*2 The regenerative frequency for motor combinations with the SGDH-60AE/-75AE assume that the JUSP-RA04 or JUSP-RA05 Regenerative Resistor Unit is used. For information on regenerative resistor units, refer to *5.6.1 External Regenerative Resistors* or to *5.2.5 Regenerative Resistor Units* in this manual.

Voltage			Three-phase 200V							
Servo Amplifier Model SGDH-			—	—	10AE	15AE	20AE	30AE	40AE	50AE
SGMSH Series	Applicable Servo-motor	Model SGMSH-	—	—	10A	15A	20A	30A	40A	50A
		Capacity (kW)	—	—	1.0	1.5	2.0	3.0	4.0	5.0
		Motor Speed (rpm)	Rated 3000/maximum 5000							
	Applicable Encoder		Standard: 17-bit incremental encoder							
	Continuous Output Current A_{rms}		—	—	5.7	9.7	12.7	18.8	25.4	28.6
	Maximum Output Current A_{rms}		—	—	17	28	42	56	77	84
	Allowable Regenerative Frequency*1 (times/min)		—	—	39	31	48	20	29	22

*1 Allowable regenerative frequency is the number of times the servomotor is allowed to accelerate and decelerate through a 0rpm → maximum motor speed → 0rpm cycle in a minute.

■ Specifications for Servo Amplifier and Single-phase, 100V Servomotor Combinations

Voltage			Single-phase 100V			
Servo Amplifier Model SGDH-			A3BE	A5BE	01BE	02BE
SGMAH Series	Applicable Servomotor	Model SGMAH-	A3B	A5B	01B	02B
		Capacity (kW)	0.03	0.05	0.1	0.2
		Motor Speed (rpm)	Rated 3000/maximum 5000			
	Applicable Encoder		Standard: 13-bit incremental encoder			
	Continuous Input Current *1 A_{rms}		1.1	1.8	3.0	5.2
	Continuous Output Current A_{rms}		0.66	0.95	2.4	3.0
	Maximum Output Current A_{rms}		2.0	2.9	7.2	9.0
	Allowable Regenerative Energy*2 (Joules)		7.8	15.7		

Voltage			Single-phase 100V			
Servo Amplifier Model SGDH-			A3BE	A5BE	01BE	02BE
SGMPH Series	Applicable Servomotor	Model SGMPH-	—	—	01B	02B
		Capacity (kW)	—	—	0.1	0.2
		Motor Speed (rpm)	Rated 3000/maximum 5000			
	Applicable Encoder		Standard: 13-bit incremental encoder			
	Continuous Output Current A_{rms}		—	—	2.2	2.7
	Maximum Output Current A_{rms}		—	—	7.1	8.4
	Allowable Regenerative Energy*2 (Joules)		—		15.7	

*1 Input current rates are at the lower range of the voltage specifications.

*2 Allowable regenerative energy is the value with an AC input power supply voltage of $200V_{rms}$. This may vary with power supply fluctuation.

Note: Refer to *5.6 Selecting a Regenerative Resistor* for more details on allowable regenerative energy and frequency.

■ Specifications for Servo Amplifier and Three-phase, 400V Servomotor Combinations

Voltage			Three-phase 400V									
Servo Amplifier Model SGDH-			05DE	10DE	15DE	20DE	30DE	50DE	60DE	75DE	1ADE	1EDE
SGMGH Series	Applicable Servomotor	Model SGMGH-	05D	09D	13D	20D	30D	44D	55D	75D	1AD	1ED
		Capacity (kW)	0.45	0.85	1.3	1.8	2.9	4.4	5.5	7.5	11	15
		Motor Speed (rpm)	Rated 1500/maximum 3000								Rated 1500/ maximum 2000	
	Applicable Encoder		Standard: 17-bit incremental encoder									
	Continuous Output Current A_{rms}		1.9	3.5	5.4	8.4	11.9	16.5	20.8	25.4	28.1	37.2
	Maximum Output Current A_{rms}		5.5	8.5	14	20	28	40.5	55	65	70	85
	Allowable Regenerative Frequency*1 (times/min)		42	15	10	12	8	11	26	18	36	32
SGMSH Series	Applicable Servomotor	Model SGMSH-	—	10D	15D	20D	30D	40D	50D	—		
		Capacity (kW)	—	1.0	1.5	2.0	3.0	4.0	5.0	—		
		Motor Speed (rpm)	Rated 3000/maximum 5000									
	Applicable Encoder		Standard: 17-bit incremental encoder									
	Continuous Output Current A_{rms}		—	2.8	4.7	6.2	8.9	12.5	13.8	—		
	Maximum Output Current A_{rms}		—	8.5	14	19.5	28	38	42	—		
	Allowable Regenerative Frequency* (times/min)		—	47	31	48	20	29	22	—		

*1 Allowable regenerative frequency is the number of times the servomotor is allowed to accelerate and decelerate through a 0rpm → maximum motor speed → 0rpm cycle in a minute.

Voltage			Three-phase 400V				
Servo Amplifier Model SGDH-			05DE	10DE	15DE	20AE	30DE
SGMSH Series	Applicable Servomotor	Model SGMUH-	—	10D	15D	—	30D
		Capacity (kW)	—	1.0	1.5	—	2.9
		Motor Speed (rpm)	Rated 6000/maximum 6000				
	Applicable Encoder		Standard: 17-bit incremental encoder				
	Continuous Output Current A_{rms}		—	2.7	4.1	—	8.1
	Maximum Output Current A_{rms}		—	8.5	14	—	28
	Allowable Regenerative Frequency*1 (times/min)		—	27	19	—	13

*1 Allowable regenerative frequency is the number of times the servomotor is allowed to accelerate and decelerate through a 0rpm → maximum motor speed → 0rpm cycle in a minute.

Note: Refer to *5.6 Selecting a Regenerative Resistor* for more details on allowable regenerative energy and frequency.

8.2.2 Ratings and Specifications

The following table shows ratings and specifications for the SGDH servo amplifier to use in selecting the appropriate servo amplifier.

■ Servo Amplifier Ratings and Specifications Table 1

The table's input current rates are at the lower range of the voltage specifications.

Servo Amplifier Model SGDH-			A3	A5	01	02	04	05	08	10	15	20	30
Applicable Servomotor	100V	SGMAH-□B	A3	A5	01	02	—	—	—	—	—	—	—
		SGMPH-□B	—	—	01	02	—	—	—	—	—	—	—
	200V	SGMAH-□A	A3	A5	01	02	04	—	08	—	—	—	—
		SGMPH-□A	—	—	01	02	04	—	08	—	15	—	—
		SGMGH-□A□A (1500rpm)	—	—	—	—	—	05	—	09	13	20	30
		SGMSH-□A	—	—	—	—	—	—	—	10	15	20	30
	400V	SGMGH-□D	—	—	—	—	—	05	—	09	13	20	30
		SGMSH-□D	—	—	—	—	—	—	—	10	15	20	30
		SGMUH-□D	—	—	—	—	—	—	—	10	15	—	30
Basic Specifications	Maximum Applicable Servomotor Capacity [kW]		0.03	0.05	0.1	0.2	0.4	0.45	0.75	1.0	1.5	2.0	3.0
	100V	Continuous Input Current [A_{rms}]	1.1	1.8	3.0	5.2	—	—	—	—	—	—	—
		Continuous Output Current [A_{rms}]	0.66	0.95	2.4	3.0	—	—	—	—	—	—	—
		Maximum Output Current [A_{rms}]	2.0	2.9	7.2	9.0	—	—	—	—	—	—	—
	200V	Continuous Input Current [A_{rms}]	0.82	1.1	2.0	3.4	5.5	4.0	5.4	7.0	9.5	12.0	17.0
		Continuous Output Current [A_{rms}]	0.44	0.64	0.91	2.1	2.8	3.8	5.7	7.6	11.6	18.5	24.8
		Maximum Output Current [A_{rms}]	1.3	2.0	2.8	6.5	8.5	11.0	13.9	17	28	42	56
	400V	Continuous Input Current [A_{rms}]	—	—	—	—	—	2.0	—	3.5	4.8	6	8.5
		Continuous Output Current [A_{rms}]	—	—	—	—	—	1.9	—	3.5	5.4	8.4	11.9
		Maximum Output Current [A_{rms}]	—	—	—	—	—	5.5	—	8.5	14	20	28

Servo Amplifier Ratings and Specifications Table 1 (continued)

Servo Amplifier Model SGDH-				A3	A5	01	02	04	05	08	10	15	20	30
Basic Specifications	Input Power Supply*1 *2	Main Circuit	100V	For Single-phase 100 to 115V_{ac} +10 to -15%, 50/60Hz										
			200V	Single/Three-phase 200 to 230V_{ac} +10 to -15%, 50/60Hz										
			400V	Three-phase. 380 to 480V_{AC} +10 to -15%, 50/60Hz										
		Control Circuit	100V	For Single-phase 100 to 115V_{ac} +10 to -15%, 50/60Hz										
			200V	For Single-phase 200 to 230.5V_{ac} +10 to -15%, 50/60Hz										
			400V	24V_{DC} ±15%										
	Control Method			Single or three-phase full-wave rectification IGBT-PWM (sinewave driven)										
	Feedback			Serial encoder: 13- (incremental only), 16-, or 17-bit (incremental/absolute).										
	Conditions	Ambient/Storage Temperature*3		0 to +55°C/-20 to +85°C (When enclosed, internal temperatures must not exceed this range.)										
		Ambient/Storage Humidity		90% relative humidity or less (with no condensation)										
		Vibration/Shock Resistance		4.9 m/s^2/19.6 m/s^2										
	Configuration			Base mounted (Rack mounted optional).										
	Approx. Mass [lb (kg)]	For 100V		1.76 (0.8)			2.43 (1.1)	—						
		For 200V					1.76 (0.8)	2.43 (1.1)	3.75 (1.7).			6.17 (2.8)	8.38 (3.8)	
		For 400V		—	—	—	—		3.75 (1.7)	—	3.75 (1.7)			

*1 Supply voltage must not exceed 230V +10% (253V) or 115V + 10% (127V). A step-down transformer is required if the voltage exceeds these values.

*2 Main power supply for SGDH-08AE-S and -15AE-S is single-phase, 220 to 230V_{ac} +10 -15%, 50/60Hz
If supply power is less than 187V, Alarm 41 may occur when accelerating to maximum speed at full torque.

*3 Use the servo amplifier within the ambient temperature range. When enclosed, internal temperatures must not exceed the specified range.

Servo Amplifier Ratings and Specifications Table 1 (continued)

Servo Amplifier Model SGDH-				A3	A5	01	02	04	05	08	10	15	20	30
Speed and Torque Control Modes	Performance	Speed Control Range		1:5000 (The lowest speed of the speed control range is the point just before the motor stops under full-load condition.)										
		Speed Regulation*1	Load Regulation	0 to 100% load: 0.01% maximum (at rated speed)										
			Voltage Regulation	Rated Voltage ±10%: 0% (at rated speed)										
			Temperature Regulation	25 ± 25°C: ±0.1% max. (at rated speed)										
		Frequency Characteristics		400Hz (at $J_L = J_M$)										
		Torque Control Tolerance (Repeatability)		±2%										
		Soft Start Time Setting		0 to 10s (Can be set individually for acceleration and deceleration)										
	Input Signals	Speed Reference Input	Reference Voltage*2	±6V_{DC} (Variable setting range: ±2 to ±10V_{DC}) at rated torque (positive torque reference with positive reference), input voltage: ±12V (maximum).										
			Input Impedance	About 14kΩ										
			Circuit Time Constant	—										
		Torque Reference Input	Reference Voltage*2	±3V_{DC} (Variable setting range: ±1 to ±10V_{DC}) at rated torque (positive torque reference with positive reference), input voltage: ±12V (maximum)										
			Input Impedance	About 14kΩ										
			Circuit Time Constant	About 47μs										
		Contact Speed Reference	Rotation Direction Selection	With P control signal (/P-CON)										
			Speed Selection	With forward/reverse current limit signal (speed 1 to 3 selection), servomotor stops or another control method is used when both are OFF.										
Position Control Mode	Performance	Bias Setting		0 to 450rpm (setting resolution: 1rpm)										
		Feed Forward Compensation		0 to 100% (setting resolution: 1%)										
		Positioning Completed Width Setting		0 to 250 reference units (setting resolution: 1 reference unit)										
	Input Signals	Reference Pulse	Type	Sign + pulse train, 90° phase difference 2-phase pulse (A phase + B phase), or CCW + CW pulse train										
			Form	Line driver (+5V level), open collector (+5V or +12V level)										
			Frequency	500/200kpps maximum (line driver/open collector).										
		Control Signal		Clear Signal (input pulse form identical to reference pulse)										
		Built-in Open-Collector Power Supply*3		+12V (1kΩ built-in resistor)										

*1 Speed regulation is defined as follows:
The motor speed may change due to voltage variations or amplifier drift and changes in processing resistance due to temperature variation. The ratio of speed changes to the rated speed represents speed regulation due to voltage and temperature variations.

*2 Forward is clockwise viewed from the non-load side of the servomotor, (counterclockwise viewed from the load and shaft end).

*3 The built-in open collector power supply is not electrically isolated from the control circuit in the servo amplifier.

Servo Amplifier Ratings and Specifications Table 1 (continued)

Servo Amplifier Model SGDH-			A3	A5	01	02	04	05	08	10	15	20	30
I/O Signals	Position	Form	A-, B-, C-phase line driver S-phase line driver (only with an absolute encoder)										
		Frequency Dividing Ratio	Any										
	Sequence	Signal allocation can be modified	Servo ON, P control (or Control Mode switching, forward/reverse motor rotation by internal speed setting, zero clamping, reference pulse prohibited), forward run prohibited (P-OT), reverse run prohibited (N-OT), alarm reset, forward current limit, and reverse current limit (or internal speed selection)										
	Sequence	Fixed Output	Servo alarm, 3-bit alarm codes										
		Signal allocation can be modified	Positioning completed (speed coincidence), during servomotor rotation, servo ready, during current limiting, during speed limiting, brake released, warning, selecting three of the NEAR signals.										
Internal Functions	Dynamic Brake		Operated at main power OFF, servo alarm, servo OFF, or overtravel.										
	Regeneration		External regenerative resistor.					Built-in.					
	Overtravel Stop		Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop.										
	Electronic Gear		$0.01 \leq A/B \leq 100$										
	Protection		Overcurrent, overvoltage, low voltage, overload, regeneration error, main circuit voltage error, heat sink overheated, no power supply, overflow, overspeed, encoder error, overrun, CPU error, parameter error, etc.										
	LED Display		Charge, Power, five 7-segment LEDs (built-in digital operator functions)										
	CN5 Analog Monitoring		Analog monitor connector built in for monitoring speed, torque and other reference signals. Speed: 1V/1000rpm Torque: 1V/rated torque Pulses remaining: 0.05V/reference unit or 0.05V/100 reference units										
	Communications	Connected Devices	Digital operator (hand-held model), RS-422A port such as for a personal computer (RS-232C ports under certain conditions)										
		1:N Communications	Up to N = 14 for RS-422A ports										
		Axis Address Setting	Set with parameters.										
		Functions	Status display, parameter setting, monitor display, alarm trace-back display, JOG and auto-tuning operations, speed, torque reference signal, and other drawing functions.										
		Others	Reverse rotation connection, origin search, automatic servomotor ID, DC reactor connection terminal for high power supply frequency control*										

■ Servo Amplifier Ratings and Specifications Table 2

Servo Amplifier Model SGDH-				50		60	75	1A	1E
Applicable Servomotor	200V	SGMGH-□A□A		44		55	75	1A	1E
		SGMSH-□A		40	50	—	—	—	—
	400V	SGMGH-□D		44		55	75	1A	1E
		SGMSH-□D		40	50	—	—	—	—
		SGMUH-□D		40		—	—	—	—
BasicSpecifications	Maximum Applicable Servomotor Capacity [kW]			5.0		6.0	7.0	11	15
	200V	Continuous Input Current [A_{rms}]		24		32	41	60	80
		Continuous Output Current [A_{rms}]		32.9		46.9	54.7	58.6	78.0
		Maximum Output Current [A_{rms}]		84		110	130	140	170
	400V	Continuous Input Current [A_{rms}]		14.9		17.8	22.3	32.7	44.6
		Continuous Output Current [A_{rms}]		16.5		21.1	27.4	28.1	37.2
		Maximum Output Current [A_{rms}]		40.5		55	65	70	85
	Input Power Supply*1	Main Circuit	200V	Three-phase 200 to 230V_{ac} +10 to -15%, 50/60Hz					
			400V	Three-phase 380 to 480V_{ac} +10 to -15%, 50/60Hz					
		Control Circuit	200V	Single-phase 200 to 230V_{ac} +10 to -15%, 50/60Hz					
			400V	24V_{DC} ±15%.					
	Control Method			Three-phase full-wave rectification IGBT-PWM (sinewave driven)					
	Feedback			Serial encoder: 17-bit (incremental/absolute).					
	Conditions	Ambient/Storage Temperature*2		0 to +55°C/-20 to +85°C					
		Ambient/Storage Humidity		90% relative humidity or less (with no condensation)					
		Vibration/Shock Resistance		4.9 m/s^2/19.6 m/s^2					
	Configuration			Base mounted (Rack mounted optional).		Base mounted. (Duct ventilated optional)			
	Approximate Mass For 200V lb. (kg)			12.1(5.5)		33.1 (15)			

Notes: *1 Supply voltage must not exceed 230V +10% (253V) or 115V + 10% (127V). A step-down transformer is required if the voltage exceeds these values.

*2 Use the servo amplifier within the ambient temperature range. When enclosed, internal temperatures must not exceed the specified range.

Servo Amplifier Ratings and Specifications Table 2 (continued)

Servo Amplifier Model SGDH-				50	60	75	1A	1E
Speed and Torque Control Modes	Performance	Speed Control Range		1:5000 (The lowest speed of the speed control range is the point just before the motor stops under full-load condition.)				
		Speed Regulation*1	Load Regulation	0 to 100% load: 0.01% maximum (at rated speed)				
			Voltage Regulation	Rated Voltage ±10%: 0% (at rated speed)				
			Temperature Regulation	25 ± 25°C: ±0.1% max. (at rated speed)				
		Frequency Characteristics		400Hz (at $J_L = J_M$)				
		Torque Control Tolerance (Repeatability)		±2%				
		Soft Start Time Setting		0 to 10s (Can be set individually for acceleration and deceleration)				
	Input Signals	Speed Reference Input	Reference Voltage*2	±6V_{DC} (Variable setting range: ±2 to ±10V_{DC}) at rated torque (positive torque reference with positive reference), input voltage: ±12V (maximum).				
			Input Impedance	About 14kΩ				
			Circuit Time Constant	—				
		Torque Reference Input	Reference Voltage*2	±3V_{DC} (Variable setting range: ±1 to ±10V_{DC}) at rated torque (positive torque reference with positive reference), input voltage: ±12V (maximum)				
			Input Impedance	About 14kΩ				
			Circuit Time Constant	About 47μs				
		Contact Speed Reference	Rotation Direction Selection	With P control signal (/P-CON)				
			Speed Selection	With forward/reverse current limit signal (speed 1 to 3 selection), servomotor stops or another control method is used when both are OFF.				
Position Control Mode	Performance	Bias Setting		0 to 450rpm (setting resolution: 1rpm)				
		Feed Forward Compensation		0 to 100% (setting resolution: 1%)				
		Positioning Completed Width Setting		0 to 250 reference units (setting resolution: 1 reference unit)				
	Input Signals	Reference Pulse	Type	Sign + pulse train, 90° phase difference 2-phase pulse (A phase + B phase), or CCW + CW pulse train				
			Form	Line driver (+5V level), open collector (+5V or +12V level)				
			Frequency	500/200kpps maximum (line driver/open collector).				
		Control Signal		Clear Signal (input pulse form identical to reference pulse)				
		Built-in Open Collector Power Supply*3		+12V (1kΩ built-in resistor)				

Note: *1 Speed regulation is defined as follows:
The motor speed may change due to voltage variations or amplifier drift and changes in processing resistance due to temperature variation. The ratio of speed changes to the rated speed represents speed regulation due to voltage and temperature variations.

*2 Forward is clockwise viewed from the non-load side of the servomotor, (counterclockwise viewed from the load and shaft end).

*3 The built-in open collector power supply is not electrically isolated from the control circuit in the servo amplifier.

Servo Amplifier Ratings and Specifications Table 2 (continued)

Servo Amplifier Model SGDH-			50	60	75	1A	1E
I/O Signals	Position Output	Form	A-, B-, C-phase line driver S-phase line driver (only with an absolute encoder)				
		Frequency Dividing Ratio	Any				
	Sequence Input	Signal allocation can be modified	Servo ON, P control (or Control Mode switching, forward/reverse motor rotation by internal speed setting, zero clamping, reference pulse prohibited), forward run prohibited (P-OT), reverse run prohibited (N-OT), alarm reset, forward current limit, and reverse current limit (or internal speed selection)				
	Sequenc Output	Fixed Output	Servo alarm, 3-bit alarm codes				
		Signal allocation can be modified	Positioning completed (speed coincidence), during servomotor rotation, servo ready, during current limiting, during speed limiting, brake released, warning, selecting three of the NEAR signals.				
Internal Functions	Dynamic Brake		Operated at main power OFF, servo alarm, servo OFF, or overtravel.				
	Regeneration		Built-in	External regenerative resistor.			
	Overtravel Stop		Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop.				
	Electronic Gear		$0.01 \leq A/B \leq 100$				
	Protection		Overcurrent, overvoltage, low voltage, overload, regeneration error, main circuit voltage error, heat sink overheated, no power supply, overflow, overspeed, encoder error, overrun, CPU error, parameter error, etc.				
	LED Display		Charge, Power, five 7-segment LEDs (built-in digital operator functions)				
	CN5 Analog Monitoring		Analog monitor connector built in for monitoring speed, torque and other reference signals. Speed: 1V/1000rpm Torque: 1V/rated torque Pulses remaining: 0.05V/reference unit or 0.05V/100 reference units				
	Communications	Connected Devices	Digital operator (hand-held model), RS-422A port such as for a personal computer (RS-232C ports under certain conditions)				
		1:N Communications	Up to N = 14 for RS-422A ports				
		Axis Address Setting	Set with parameters.				
		Functions	Status display, parameter setting, monitor display, alarm trace-back display, JOG and auto-tuning operations, speed, torque reference signal, and other drawing functions.				
	Others		Reverse rotation connection, origin search, automatic servomotor ID, DC reactor connection terminal for high power supply frequency control*1				

*1 The DC reactor connection terminals for power supplies designed to minimize the effects of harmonics are not included in servo amplifiers with capacitites of 6kW or more.

SGDH Amplifier Ratings and Specifications

Servo Amplifier Model SDGH-				2B	3Z	3G	4E	5E
Basic Specifications	Input Power Supply		Main Circuit*1	Three-phase 380 to 480V_{ac} +10% to -15%, 50/60Hz				
			Control Circuit	24V_{DC} ±10% Note: Power supply for DB contactor is made from DC24V power supply. In case the DB operation is necessary when power interruption occurs, maintain the DC24V while the DB operates. If 5 times inertia is attached and standard DB resistor is used, DB operation time is about 2 to 5 seconds			40 Watt	
	Control Mode			Three-phase, full-wave rectification IGBT PWM (sine-wave driven)				
	Feedback			Incremental encoder, absolute encoder				
	Location	Ambient/Storage Temperature*2		0 to 55°C / -20 to 85°C				
		Ambient/Storage Humidity		90% Relative Humidity or less (no-condensing)				
		Vibration/Shock Resistance		9.8m/s^2 (1G) / 49m/s^2 (5G) Cyclic shock resistance is 29.4m/s^2 (3G)				
	Structure			Base mounted				
Speed/Torque Control Mode	Performance	Speed Control Range		1 : 5000				
		Speed Regulation*3	Load Regulation	0% to 100%: 0.01% maximum (at rated speed)				
			Voltage Regulation	Rated voltage ±10%: 0% (at rated speed)				
			Temperature Regulation	25 ± 25°C: 0.1% maximum (at rated speed)				
		Frequency Characteristics		100Hz (at $J_L = J_M$)				
		Accel/Decel Time Setting		0 to 10s				
	Input Signal	Speed Reference	Reference Voltage*4	±6V_{DC} (variable setting range: ±2 to ±10V_{DC}) at rated speed (forward rotation with positive reference)				
			Input Impedance	Approximately 30kΩ				
			Circuit Time Constant	—				
		Torque Reference	Reference Voltage ****	±1 to ±10V at rated speed (forward rotation with positive reference)				
			Input Impedance	Approximately 14kΩ				
			Circuit Time Constant	Approximately 47μs				
		Contact Speed Reference	Rotation Direction Selection	Uses P control signal				
			Speed Selection	Forward/reverse rotation current control signals are used (1st to 3rd speed selection). When both signals are OFF, the motor stops or enters another control mode.				

*1 Supply voltage must not exceed 480V + 10% (528V). A stepdown transformer is required if the voltage exceeds this limit.

*2 Use the servo amplifier within the ambient temperature range. When enclosed, the temperatures inside the cabinet must not exceed the specified range.

*3 Speed regulation is defined as follows:

$$\left(\text{Speed regulation} = \frac{(\text{no-load motor speed - full-load motor speed})}{\text{rated motor speed}} \times 100\%\right)$$

*4 Forward is clockwise viewed from the non-load side of the servomotor, (counterclockwise viewed from the load and shaft end).

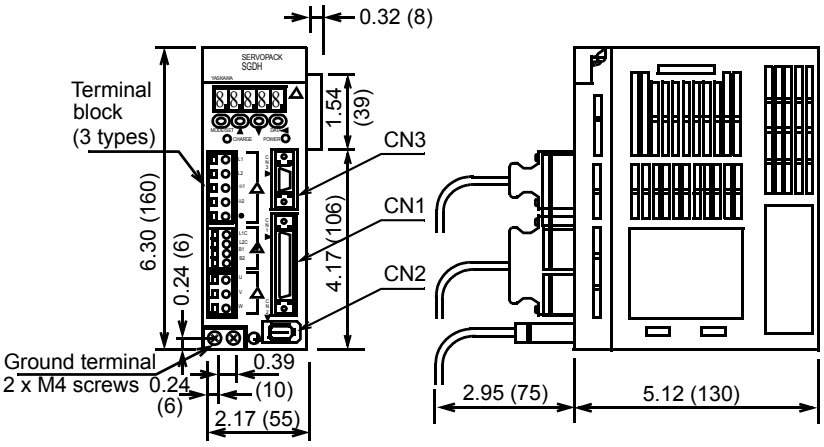
SGDH Amplifier Ratings and Specifications (cont'd)

Positioning Control Mode	Performance	Bias Setting		0 to 450rpm (setting resolution: 1rpm)
		Feed-forward Compensation		0 to 100% (setting resolution: 1%)
		Position Complete Width Setting		1 to 250 reference units (setting resolution: 1 reference unit)
	Input Signal	Reference Signal	Type	SIGN + PULSE train, 90° phase difference 2-phase pulse (phase A + phase B), or CCW + CW pulse train
			Pulse Buffer	Line driver (+5V level), open collector (+5V or +12V level)
			Pulse Frequency	Maximum 500/200kpps (line driver/open collector)
		Control SIgnal		CLEAR (input pulse form identical to reference pulse)
		Built-in Open Collector Power Supply *1		+12V (With built-in 1kΩ resistor)
I/O Signals	Position Output		Output Form	Phases A, B and C: Line driver output Phase S: Line driver output (only when absolute encoder is used)
			Frequency Dividing Ratio	Any
	Sequence Input			Servo ON, P control (or forward/reverse rotation in contact input speed control mode), forward rotation prohibited (P-OT), reverse rotation prohibited (N-OT), alarm reset, forward rotation current limit and reverse rotation current limit (or contact input speed control)
	Sequence Output			Servo alarm, 3-bit alarm codes
			Select three of the following:	Positioning complete (speed coincidence), TGON, servo ready, current limit, brake release, overload detected
Built-in Functions	Dynamic Brake (DB) (Supplied as an option unit)			Activated at main power OFF, servo alarm, servo OFF or overtravel.
	Regenerative Processing			A regenerative resistor must be mounted externally.
	Overtravel (OT) Prevention			Motor is stopped by dynamic brake (requires optional dynamic brake unit), decelerates to a stop, or coasts to a stop when P-OT or N-OT is activated.
	Protection			Overcurrent, overload, regenerative error, main circuit voltage error, heat sink overheat, power open phase, overflow, overspeed, encoder error, encoder disconnected, overrun, CPU error, parameter error.
	LED Display			POWER, ALARM, CHARGE, five 7-segment LEDs, (built-in digital operator functions)
	Analog Monitor (5CN)			Speed: 1V/1000rpm Torque: 1V/rated torque Deviation: 0.05V/reference unit or 0.05 V/100 reference units
	Communication		Interface	Digital operator (mount type or hand-held). RS422A port such as a personal computer (RS-232C port can be used if some conditions are met).
			1 : N Communication	N can be up to 14 when RS422A port is used.
			Axis Address Setting	Set with parameter.
			Functions	Status display, user constant setting, monitor display, alarm traceback display, jogging, autotuning, etc.
	Others			Zero-clamp, reverse rotation connection, jog operation, home position search, automatic servomotor ID.

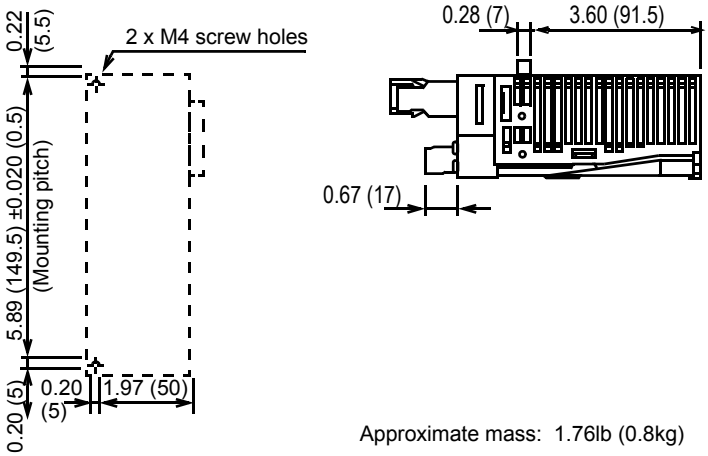
*1 The built-in open collector power supply is not electrically isolated from the control circuit in the servo amplifier.

8.2.3 Base-Mounted Servo Amplifier Dimensions in inches (mm)

■ SGDH-A3AE to -02AE (Single-phase, 200V, 30 to 200W) and SGDH-A3BE to -01BE (Single-phase, 100V, 30 to 100W)



Mounting Hole Diagram



Approximate mass: 1.76lb (0.8kg)

The same servo amplifier connector is used for SGDH-A3AE (30W) to SGDH-30AE (3.0kW) and SGDH-A3BE (30W) to SGDH-02BE (200W).

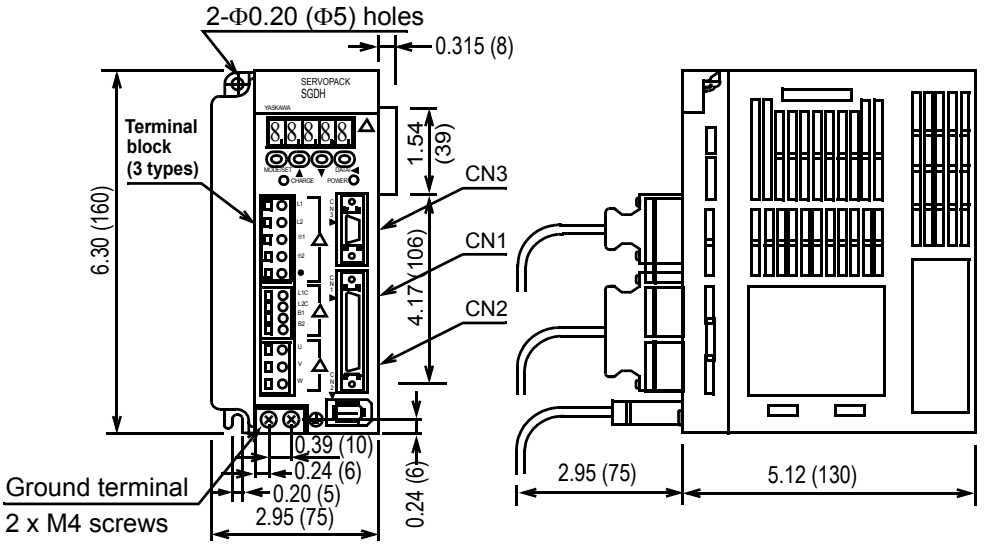
Connectors on the amplifier (supplied):

Connector Symbol	Servo Amplifier Receptacle	Manufacturer
CN1	10250-52A2JL	3M Company
CN2	53460-0611	Molex Co.
CN3	10214-52A2JL	3M Company

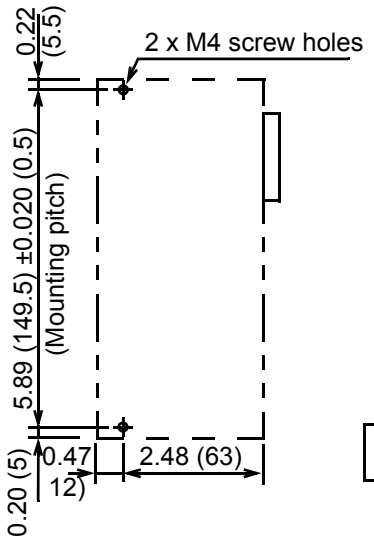
User needs to obtain the following:

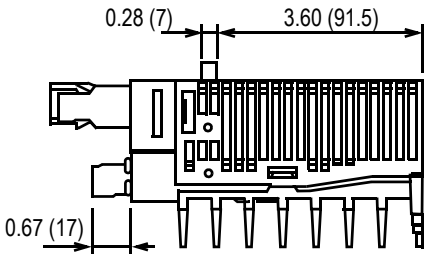
Connector Symbol	Mating Connector	Manufacturer
1CN	10150-3000VE connector 10350-52A0-008 case	3M Company
2CN	55100-0600	Molex Co.
3CN	JEZ-9S connector J-C9-2C case	JST Company

■ SGDH-04AE (Single-phase, 200V, 400W) and SGDH-02BE (Single-phase, 100V, 200W)



Mounting Hole Diagram

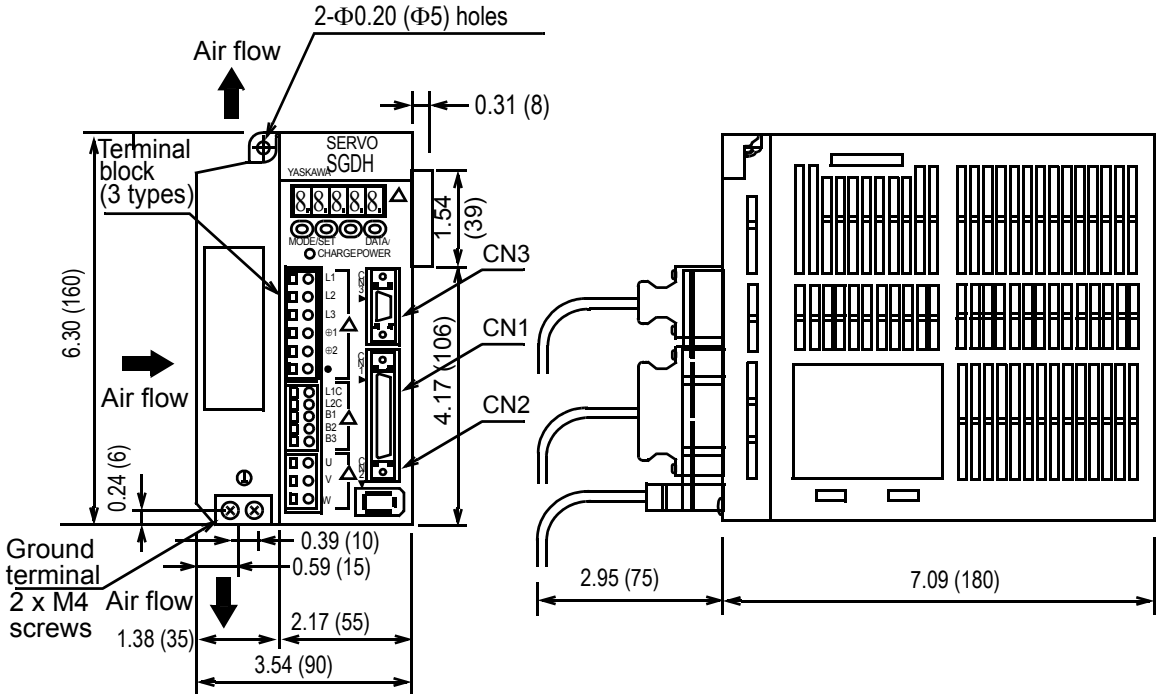




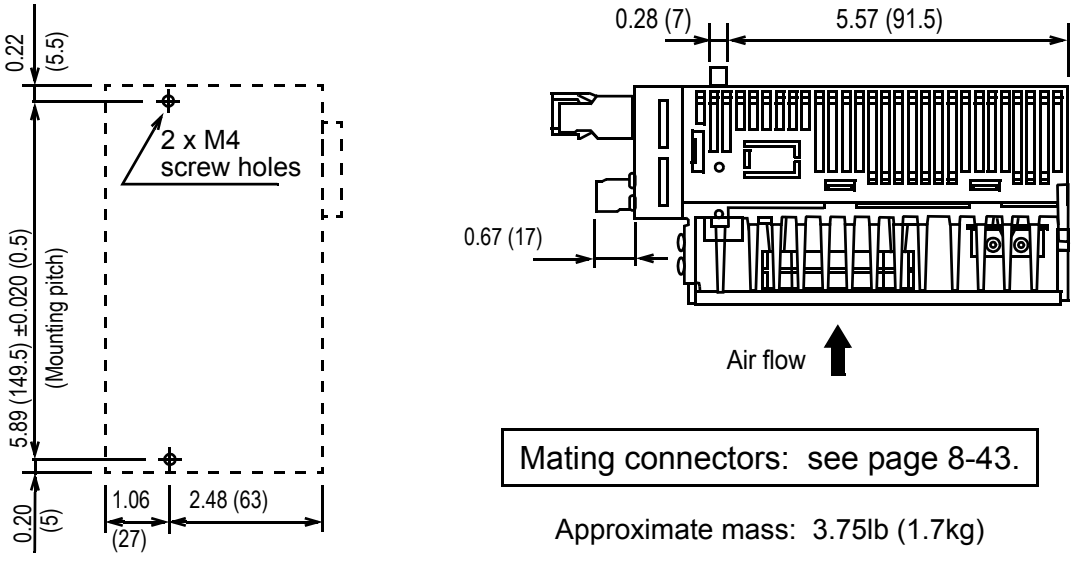
Mating connectors: see page 8-43.

Approximate mass: 2.43lb (1.1kg)

■ SGDH-05AE to-10AE (Three-phase, 200V, 0.5 to 1.0kW)
SGDH-08AE-S (Single-phase, 200V, 750W)*



Mounting Hole Diagram

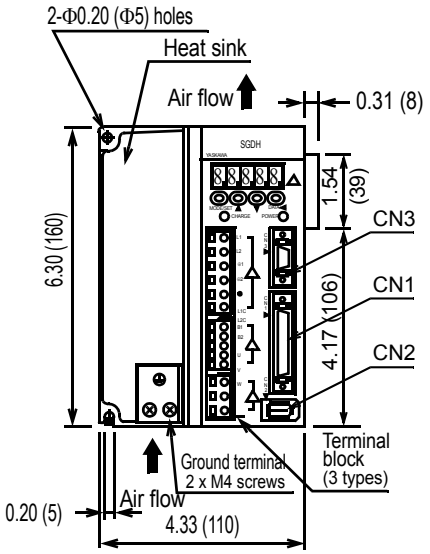


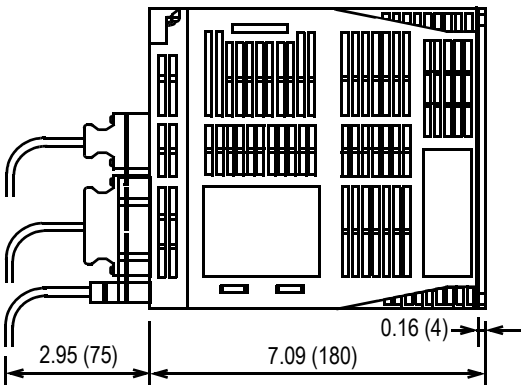
Mating connectors: see page 8-43.

Approximate mass: 3.75lb (1.7kg)

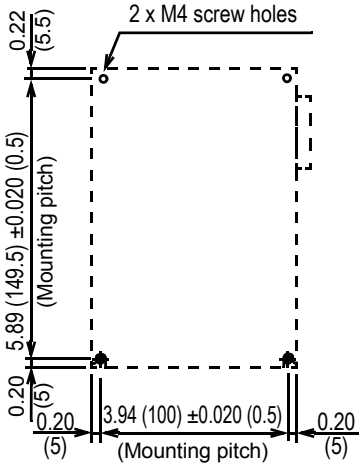
* Rating 200 to 230V_{ac} +10% -5%

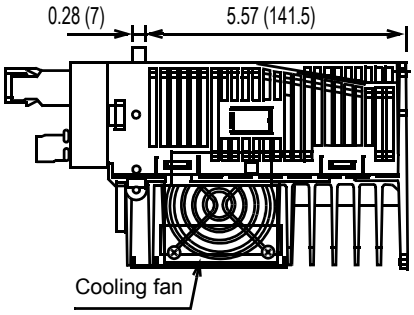
■ SGDH-15AE (Three-phase, 200V, 1.5kW)
SGDH-05DE to -15DE (Three-phase, 400V, 0.5 to 1.5kW)





Mounting Hole Diagram

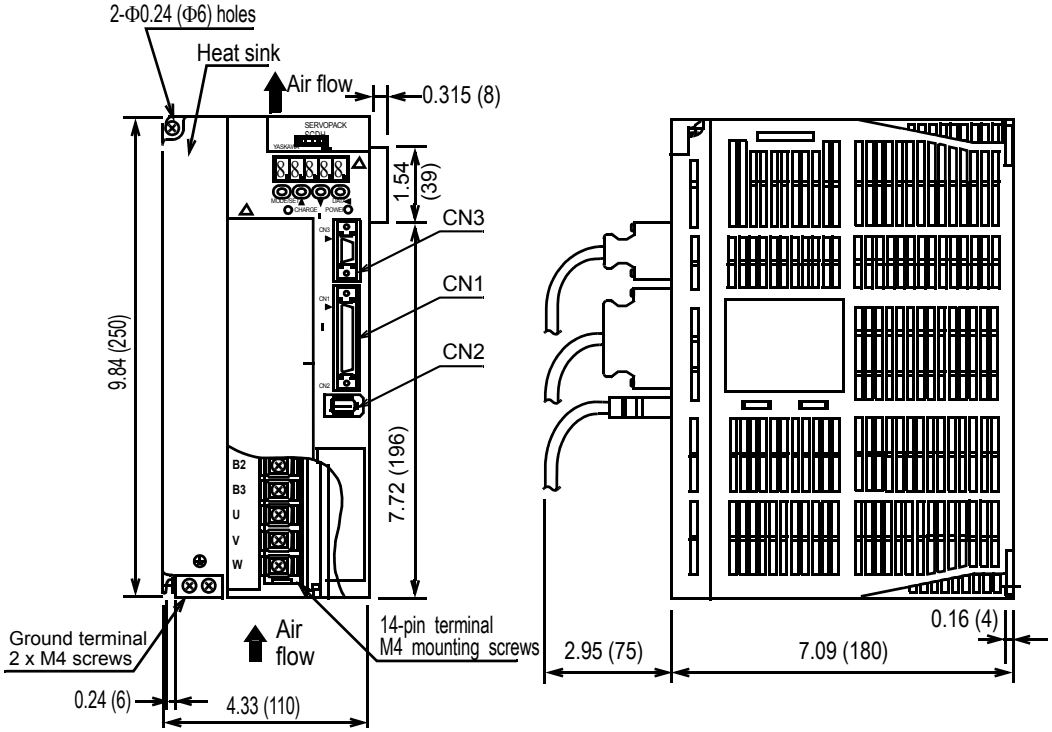




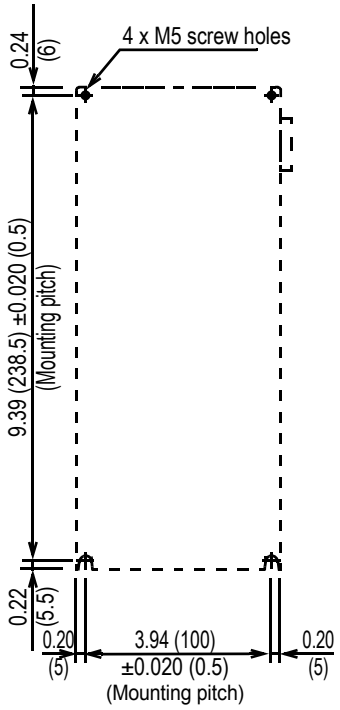
Mating connectors: see page 8-43.

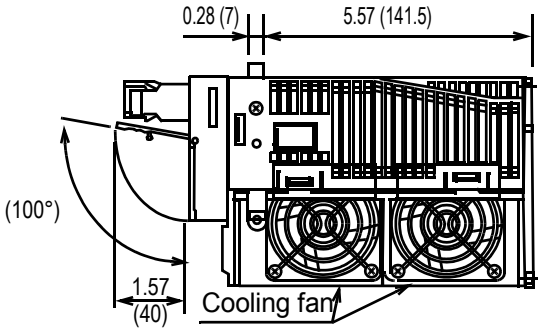
Approximate mass: 6.17lb (2.8kg)

■ SGDH-20AE, 30AE (Three-phase, 200V, 3.0kW)
SGDH-15AE-S (Single-phase, 200V, 1.5kW)*
SGDH-20DE, 30DE (Three-phase, 400V, 2.0kW, 3.0kW)



Mounting Hole Diagram



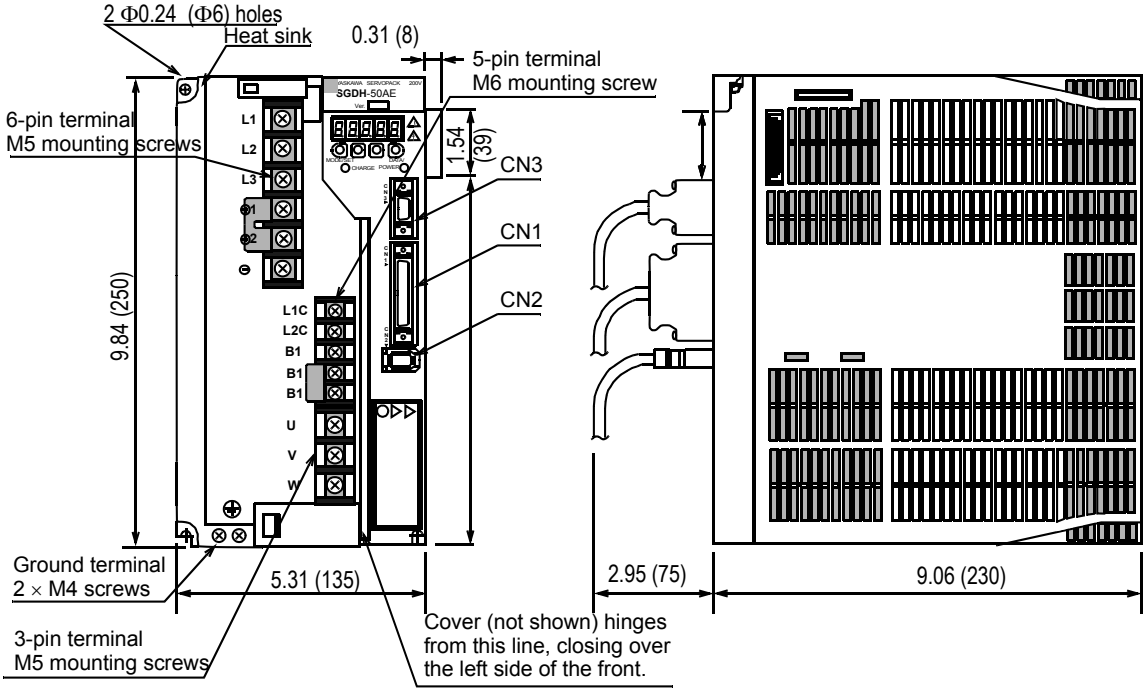


Mating connectors: see page 8-43.

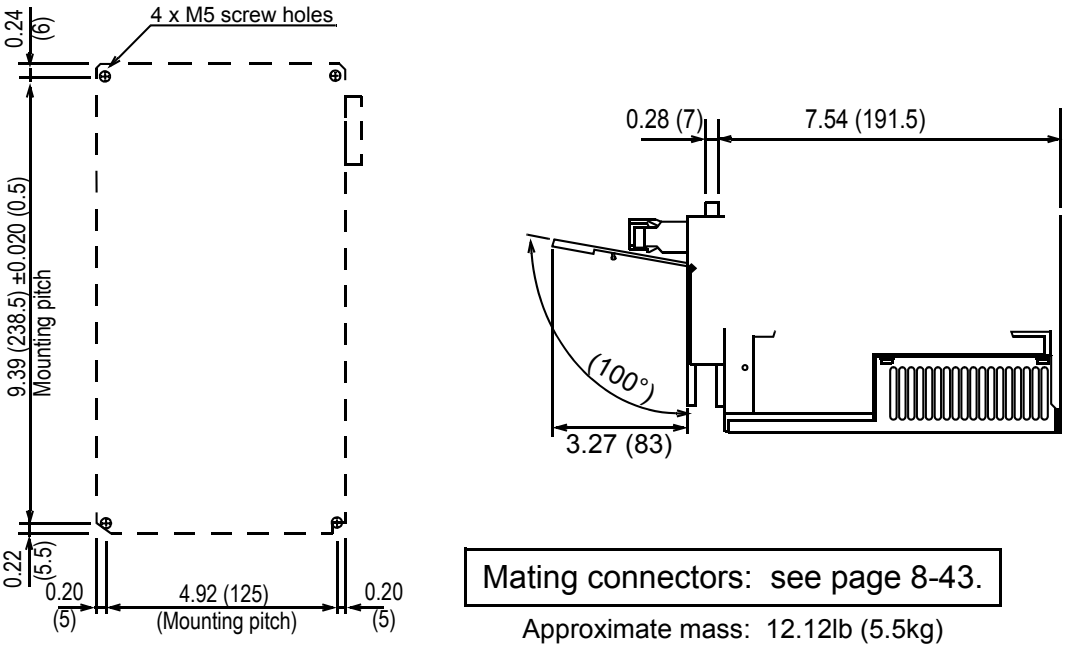
Approximate mass: 8.38lb (3.8kg)

* Rating 200 to 230V_{ac} +10% -5%

■ SGDH-50AE (Three-phase 200V, 5.0kW)
SGDH-50DE (Three-phase 200V, 5.0kW)



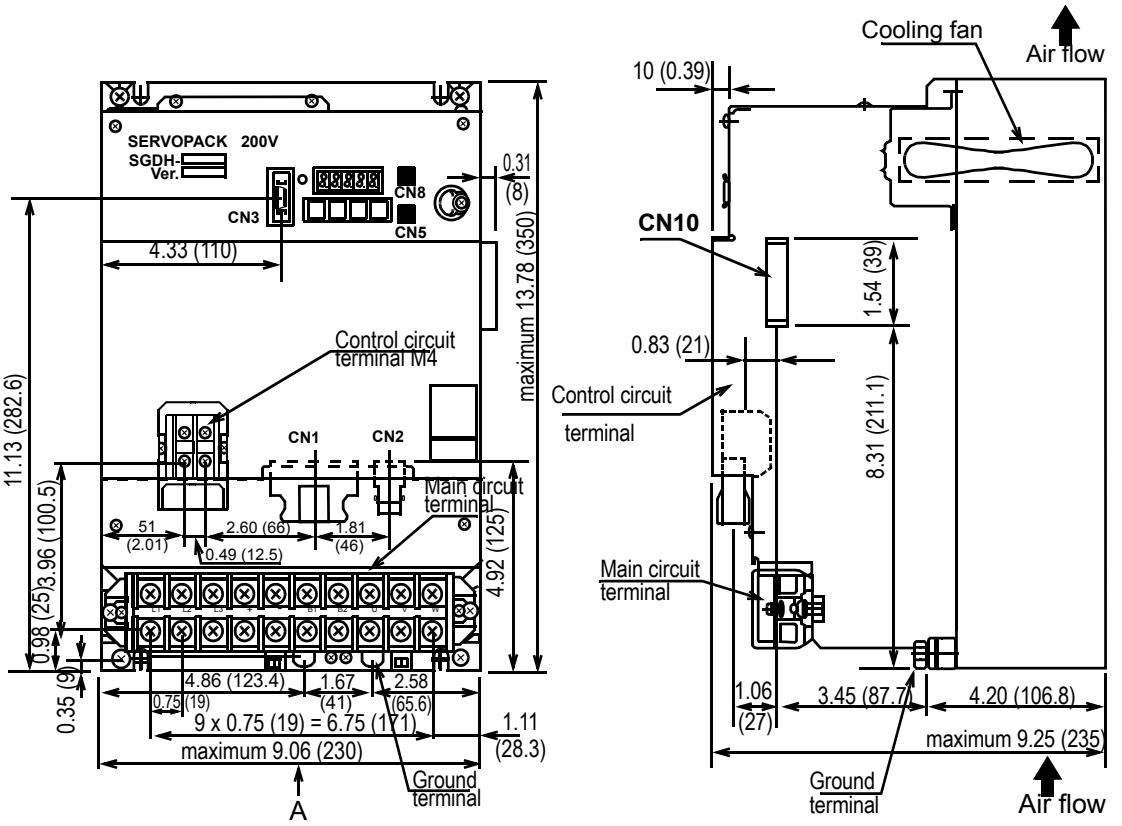
Mounting Hole Diagram



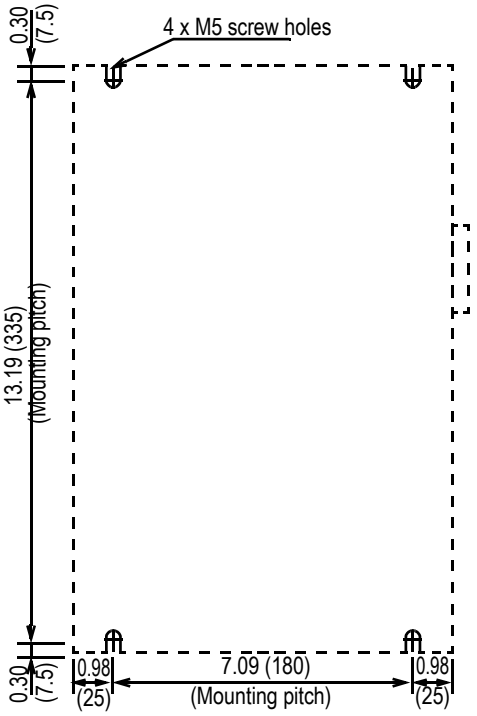
Mating connectors: see page 8-43.

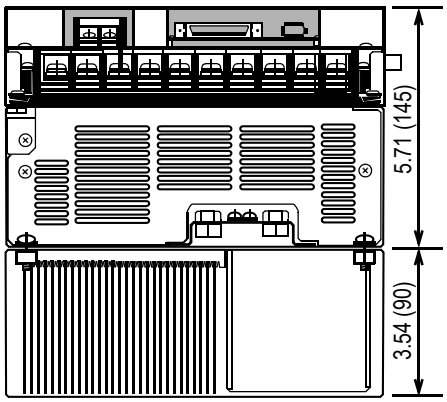
Approximate mass: 12.12lb (5.5kg)

■ SGDH-60AE, 75AE (Three-phase 200V, 6.0kW, 7.5kW)



Mounting Hole Diagram



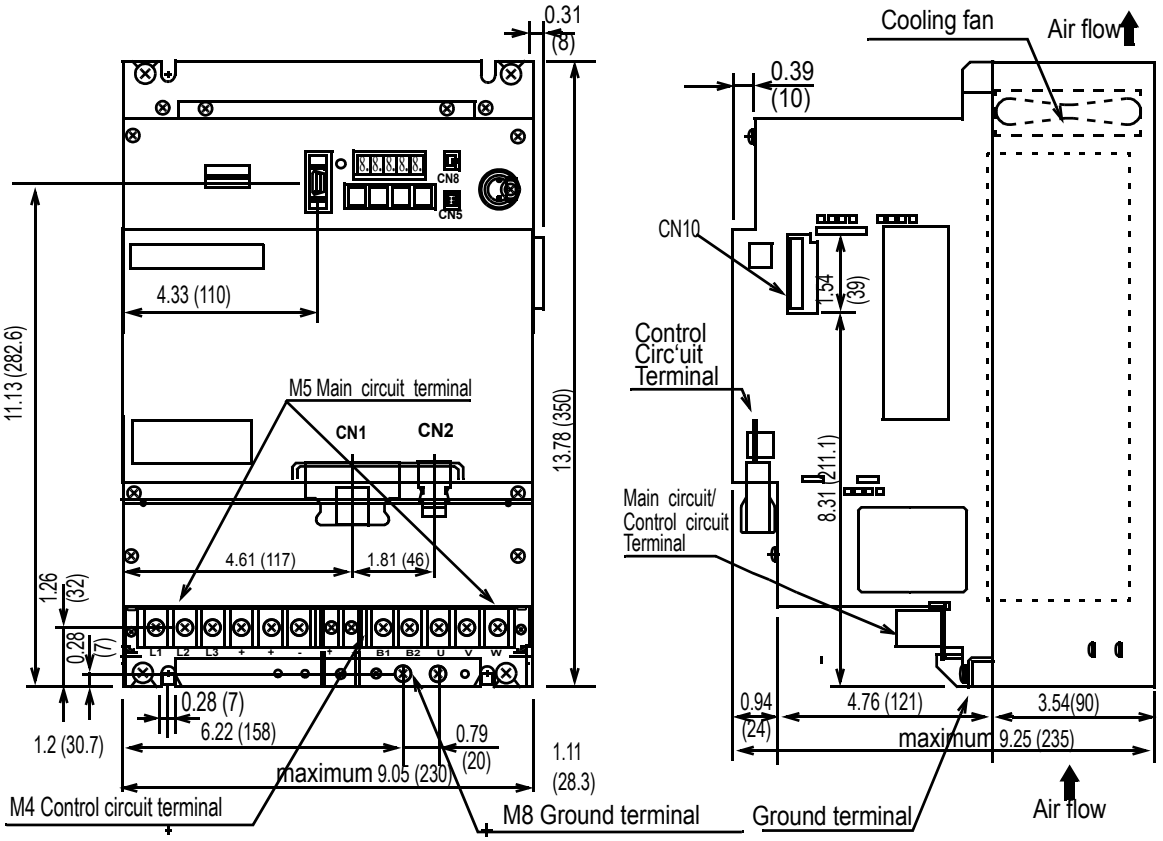


View A

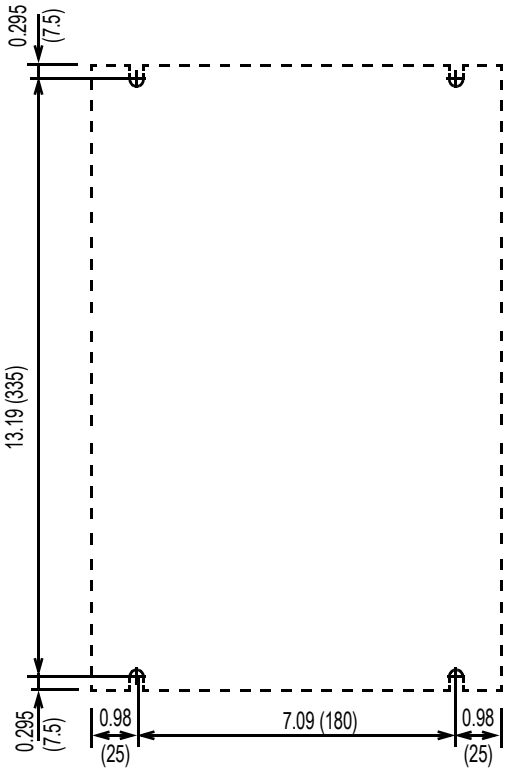
Mating connectors: see page 8-43.

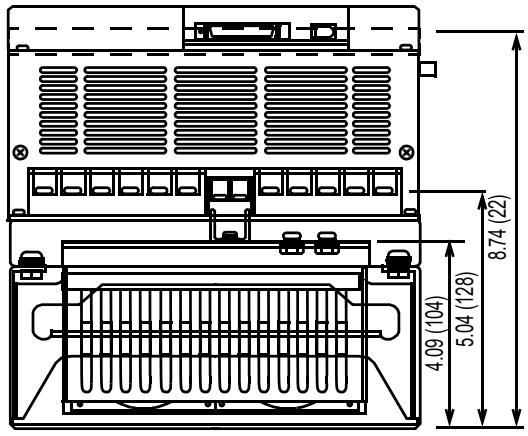
Approximate Mass: 31.5lb (14.3kg)

■ SGDH-60DE, 75DE (Three-phase 400V, 6.0kW, 7.5kW)



Mounting Hole Diagram::

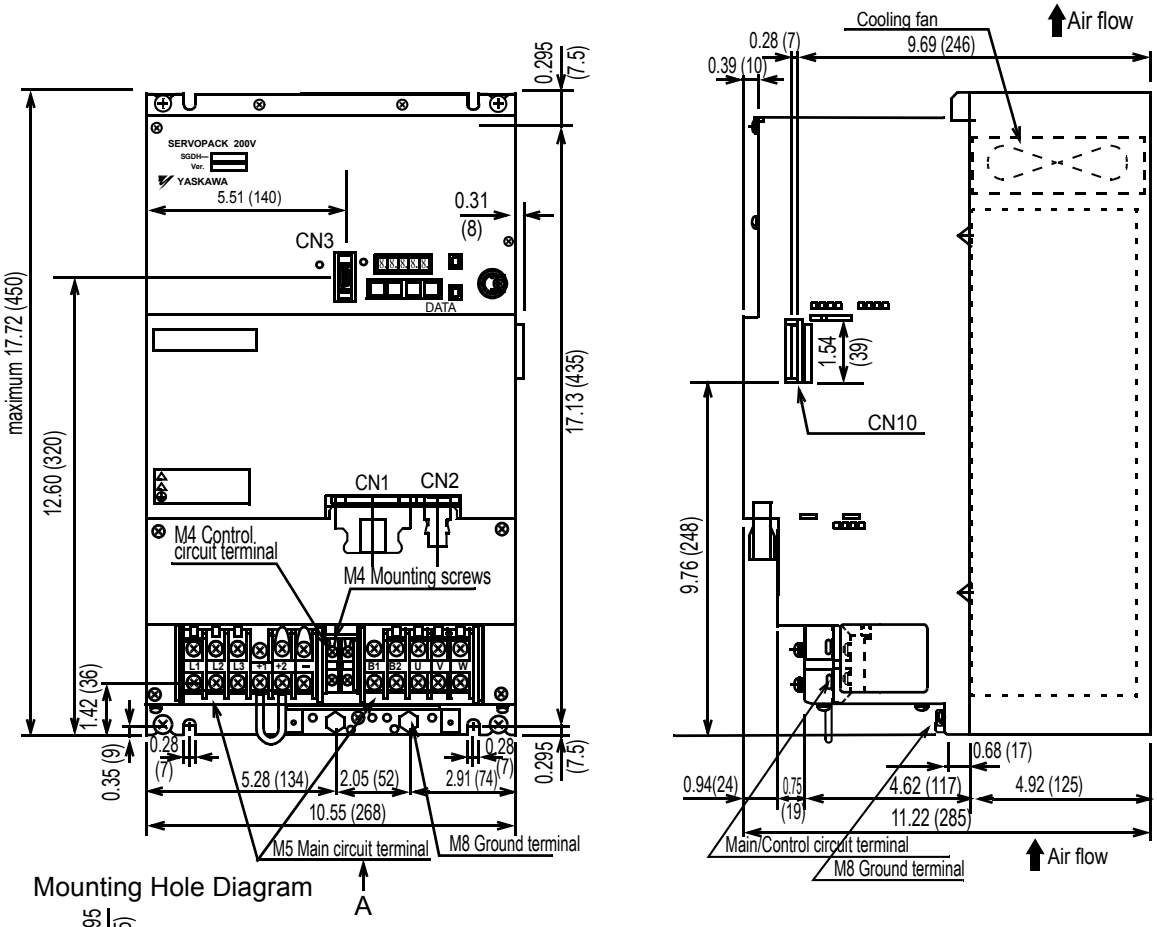




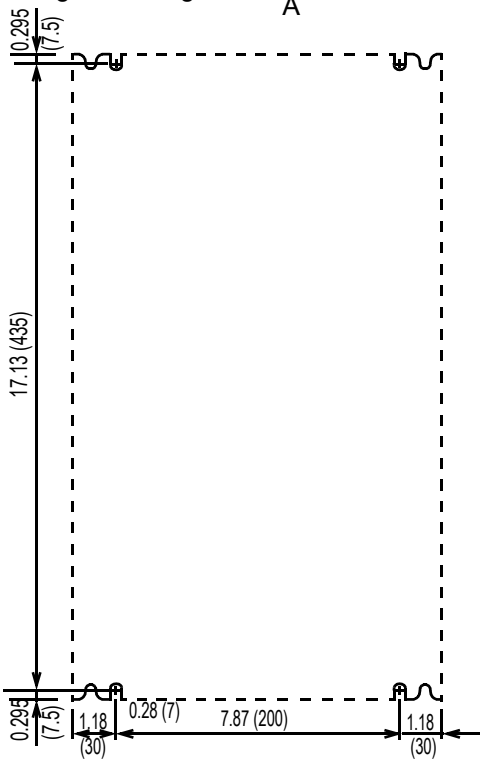
Mating connectors: see page 8-43.

Approximate mass: 29.8lb (13.5kg)

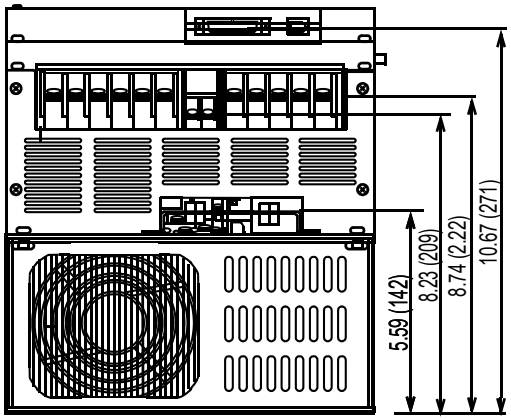
■ SGDH-1AAE, 1EAE (Three-phase 200V, 11.0kW, 15.0kW)



Mounting Hole Diagram



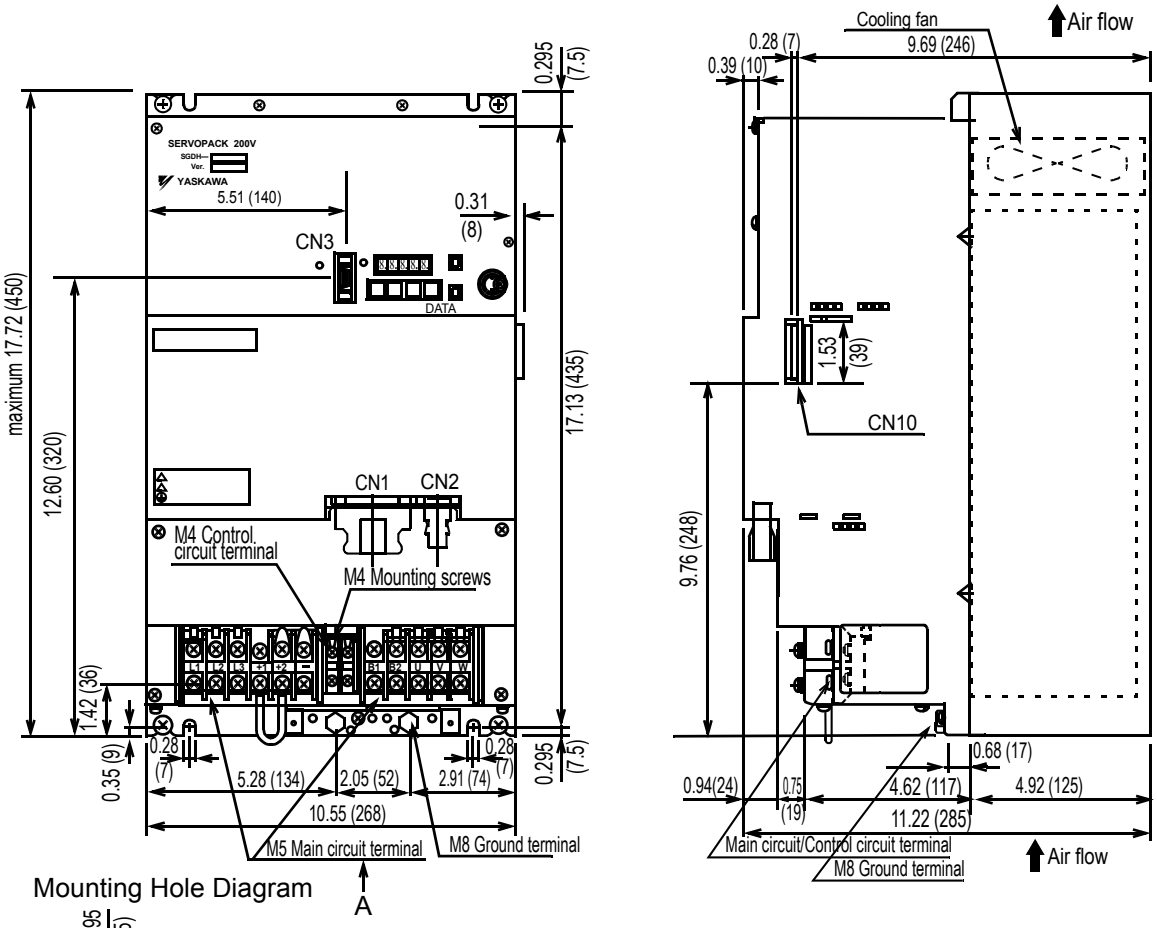
View A:



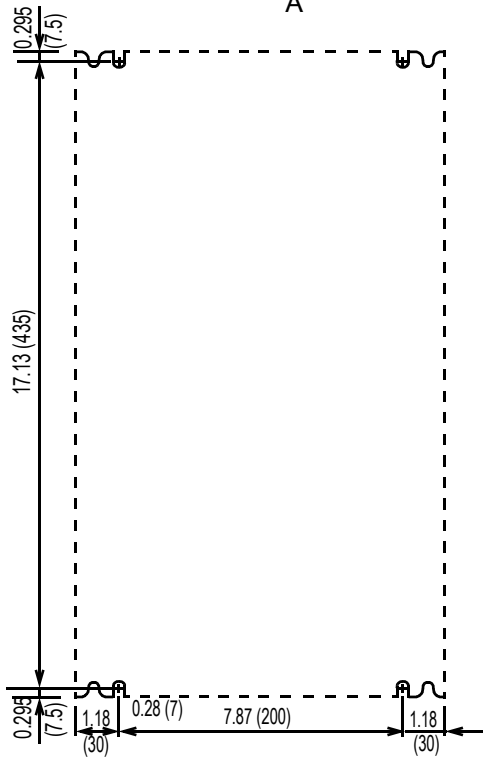
Mating connectors: see page 8-43.

Approximate mass: 31.53lb (14.3kg)

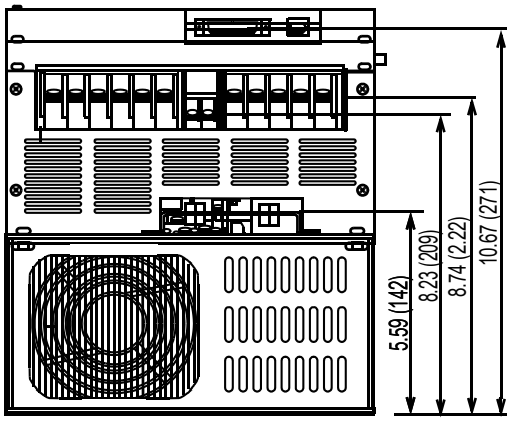
■ SGDH-1ADE, 1EDE (Three-phase 400V, 11.0kW, 15.0kW)



Mounting Hole Diagram



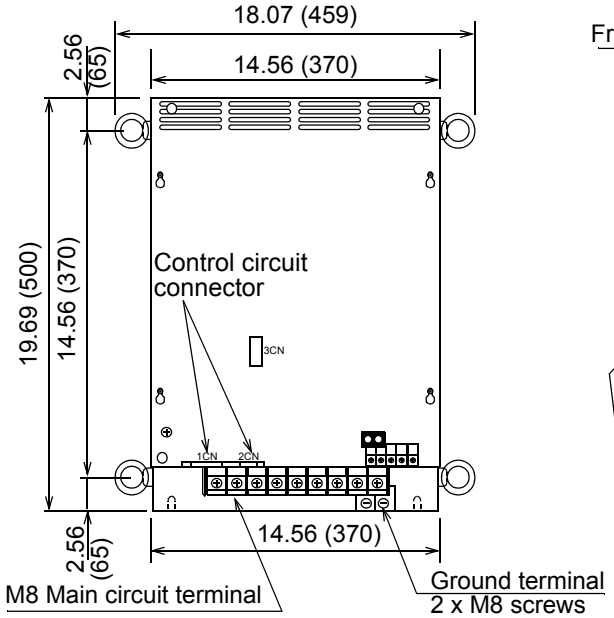
View A:

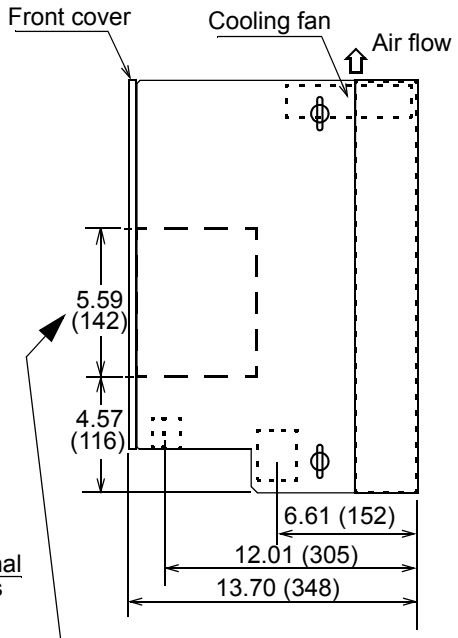


Mating connectors: see page 8-43.

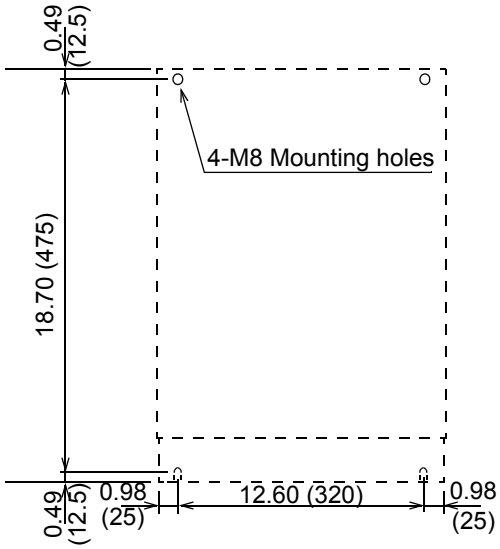
Approximate mass: 31.53lb (14.3kg)

■ SGDH-2BDE (Three-phase 400V, 22kW)





Mounting Hole Diagram



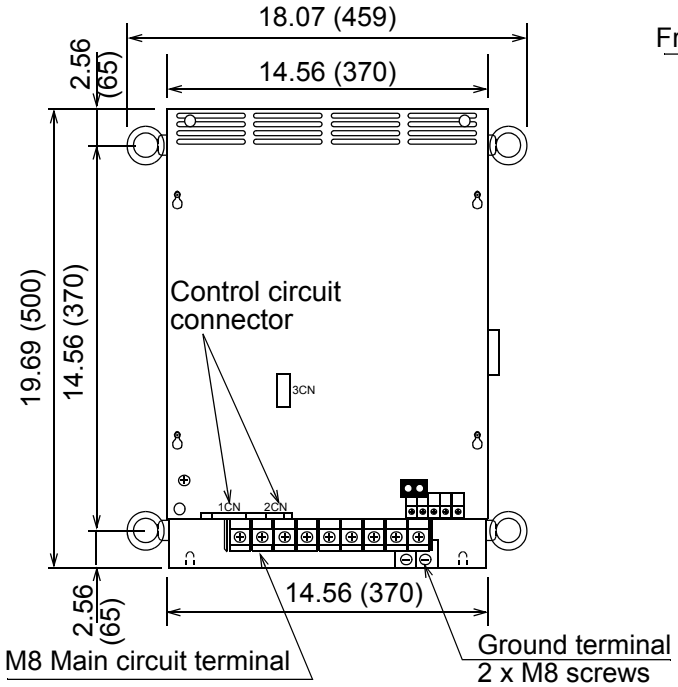
Note: Dimensions are for positioning of application module. Unlike other Sigma II amplifiers, the male connector is inset into the amplifier so that it does not protrude past the outside edge.

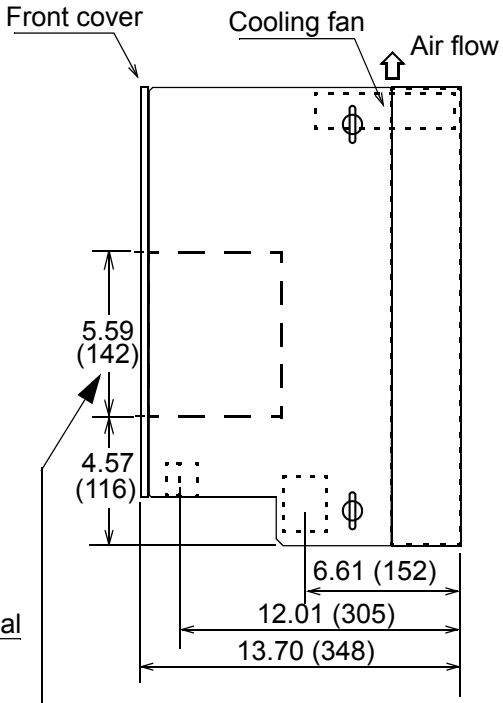
Approximate Mass: 82.2lb (40 kg)

User needs to obtain the following:

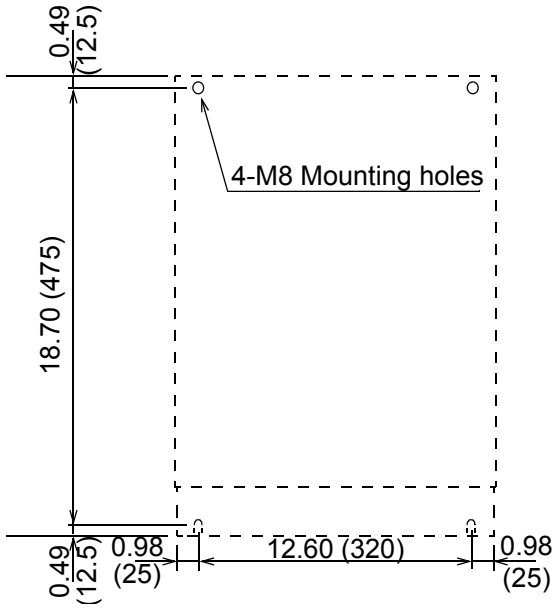
Connector Symbol	Mating Connector	Manufacturer
1CN	10150-3000VE connector 10350-52A0-008 case	3M Company
2CN	55100-0600	Molex Co.
3CN	JEZ-9S connector J-C9-2C case	JST Company

■ SGDH-3ZDE (Three-phase 400V, 30kW)





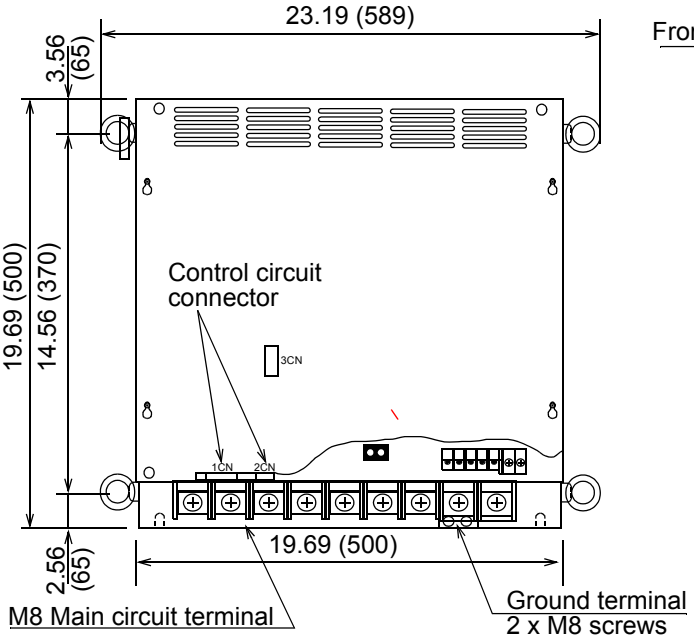
ınting Hole Diagram

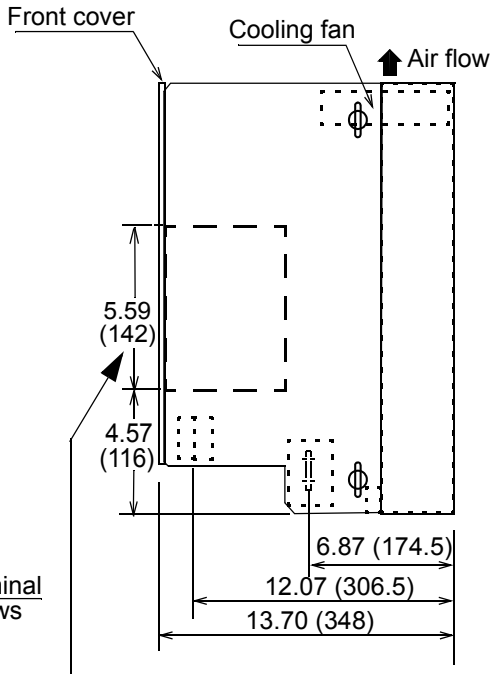


Note: Dimensions are for positioning of application module. Unlike other Sigma II amplifiers, the male connector is inset into the amplifier so that it does not protrude past the outside edge.

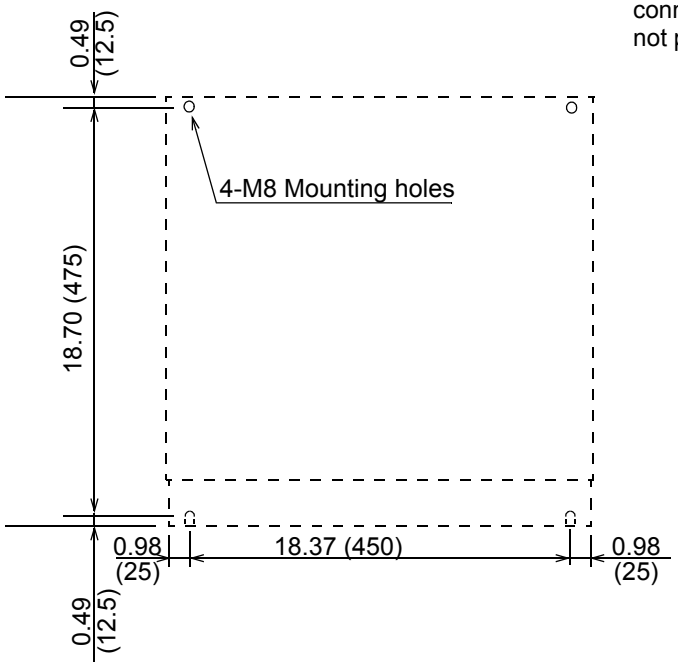
Approximate Mass: 82.2lb (40kg)

■ SGDH-3GDE (Three-phase 400V, 37kW)





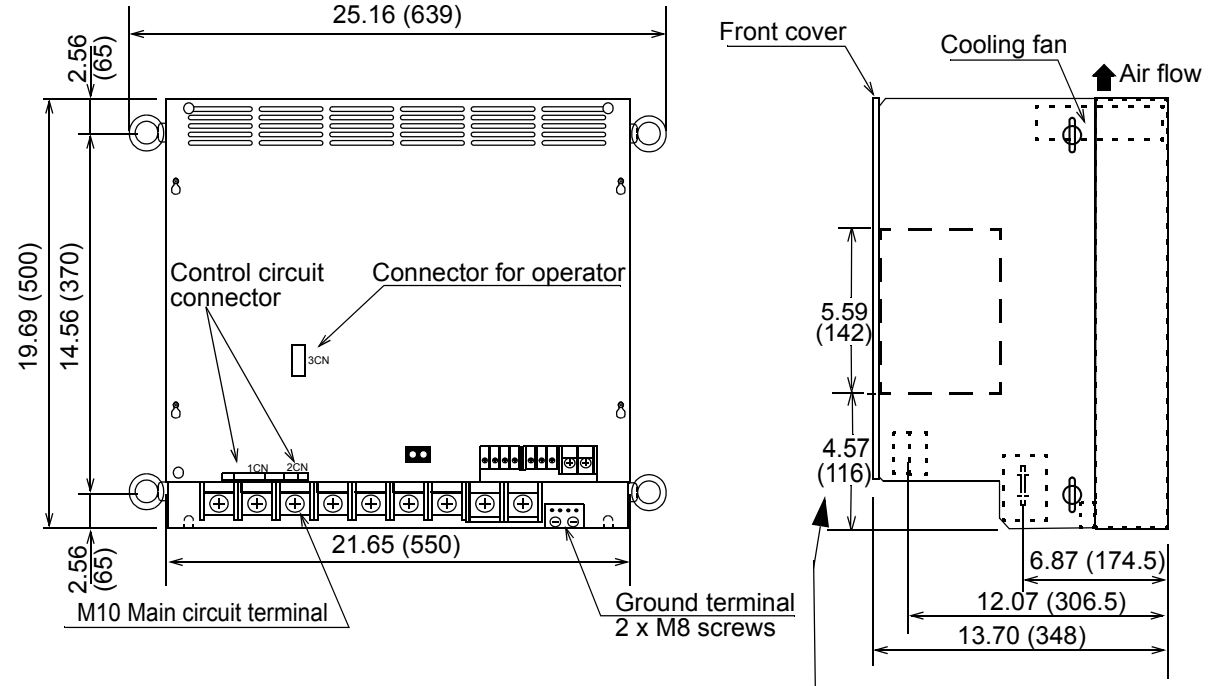
Mounting Hole Diagram



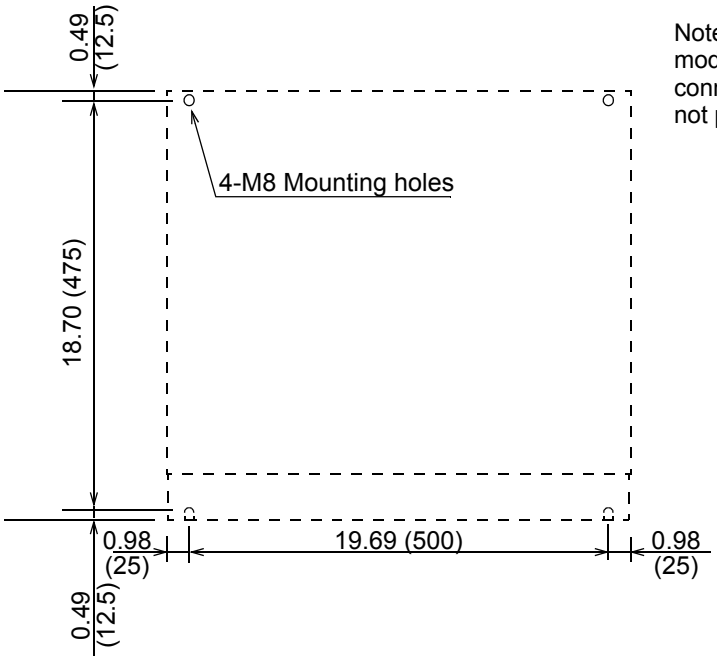
Note: Dimensions are for positioning of application module. Unlike other Sigma II amplifiers, the male connector is inset into the amplifier so that it does not protrude past the outside edge.

Approximate Mass: 132.3lb (60kg)

- **SGDH-4EDE (Three-phase 400V, 45kW)**
- **SGDH-5EDE (Three-phase 400V, 55kW)**



Mounting Hole Diagram



Note: Dimensions are for positioning of application module. Unlike other Sigma II amplifiers, the male connector is inset into the amplifier so that it does not protrude past the outside edge.

Approximate Mass: 143.3lb (65kg)

9 Inspection, Maintenance, and Troubleshooting

This chapter describes the basic inspection and maintenance to be carried out by the user. In addition, troubleshooting procedures are described for problems which generate an alarm display and for problems which result in no alarm display.

9.1 Servodrive Inspection and Maintenance 9-2
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9.1.2 Servo Amplifier Inspection 9-3
9.1.3 Replacing the Battery for the Absolute Encoder 9-4
9.2 Troubleshooting 9-5
9.2.1 Troubleshooting Problems with Alarm Displays 9-5
9.2.2 Troubleshooting Problems with No Alarm Display 9-37
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9.1 Servodrive Inspection and Maintenance

This section describes the basic inspections and maintenance of servomotors and servo amplifiers and the procedures for replacing the battery for absolute encoders.

9.1.1 Servomotor Inspection

For inspection and maintenance of servomotors, follow the simple, daily inspection procedures in the following table.

The AC servomotors are brushless. Simple, daily inspection is sufficient under most conditions. The inspection and maintenance frequencies in the table are only guidelines. Increase or decrease the frequency to suit the operating conditions and environment.

IMPORTANT

- **During inspection and maintenance, do not disassemble the servomotor.**
  If disassembly of the servomotor is required, contact Yaskawa.

Servomotor Inspection

Action or Problem	Frequency	Procedure	Comments
Vibration and Noise	Daily	Touch and listen.	Levels higher than normal?
Exterior Dirt	According to degree of contamination	Clean with cloth or compressed air.	—
Insulation Resistance Measurement	At least every year	Disconnect servo amplifier and test insulation resistance at 500V. Must exceed 10MΩ.*1	Contact Yaskawa if the insulation resistance is below 10MΩ.
Oil Seal Replacement	At least every 5000 hours	Remove servomotor from machine and replace oil seal.	Applies only to motors with oil seals.
Servomotor Overhaul	At least every 20000 hours or 5 years	Contact Yaskawa.	The user should not disassemble and clean the servomotor.

*1 Measure across the servomotor FG and the U-phase, V-phase, or W-phase power line

9.1.2 Servo Amplifier Inspection

For inspection and maintenance of the servo amplifier, follow the inspection procedures in the following table. Perform inspection and maintenance at least once every year. Other routine inspections are not required.

Servo Amplifier Inspection

Action or Problem	Frequency	Procedure	Comments
Clean interior and circuit boards	At least every year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.
Loose screws	At least every year	Check for loose terminal block and connector screws.	Tighten any loose screws.
Defective parts in unit or on circuit boards	At least every year	Check for discoloration, damage or discontinuities due to heating.	Contact Yaskawa.

■ Part Replacement Schedule

The following parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts at the frequency indicated.

The parameters of any servo amplifiers overhauled by Yaskawa are reset to the default (standard factory) settings before shipping. Be sure to confirm that the parameters are set to the application's requirements before starting operation.

Periodic Part Replacement

Part	Standard Lifespan	Replacement Method
Cooling fan	4 to 5 years	Replace with new part.
Smoothing capacitor	7 to 8 years	Test. Replace with a new part, if necessary.
Relays	—	Test. Replace if necessary.
Fuse	10 years	Replace with new part.
Aluminum electrolytic capacitor on circuit board	5 years	Test. Replace with new circuit board, if necessary.

Operating Conditions:

Ambient Temperature: Annual average of 30°C.
Load Factor: 80%, maximum.
Operation Rate: 20 hours/day, maximum.

9.1.3 Replacing the Battery for the Absolute Encoder

If the voltage of the battery for an absolute encoder drops to about 2.7V or less, an Absolute Encoder Battery Alarm (A. 83*) will occur in the servo amplifier. This alarm occurs when the servo amplifier receives a signal from the absolute encoder when the power to the servo amplifier is turned ON. Therefore, the servo amplifier will not give an alarm when the battery voltage drops below the minimum voltage level while the power is being supplied to the servo amplifier.

Refer to *5.7.3 Handling Batteries* for the battery type recommended for absolute encoders.

Replace the battery using the following procedure if the battery voltage drops below the minimum required battery voltage.

■ Battery Replacement Procedure

1. Replace the battery while the control power to the servo amplifier is ON.
2. After replacement, turn OFF the power to the servo amplifier in order to clear the Absolute Encoder Battery Alarm (A. 83).
3. Turn ON the power to the servo amplifier again and confirm that it operates properly.

Note: The absolute encoder data will be lost when the control power to the servo amplifier is turned OFF and the encoder cable is disconnected from the battery. If the data is lost, refer to *5.7.4 Absolute Encoder Setup* and follow the procedure to initialize the absolute encoder.

*Alarm A.83 is described in greater detail on page 9 - 22.

9.2 Troubleshooting

This section describes causes and remedies for problems which generate an alarm display and for problems which result in no alarm display.

9.2.1 Troubleshooting Problems with Alarm Displays

Problems that occur in the servodrives are displayed on the panel operator as "A.□□" or "CPF□□". Refer to the following sections to identify the cause of an alarm and the action to be taken.

Contact Yaskawa if the problem has not been solved after following the described procedures.

Note: "A.- -: Normal Operation", is not an alarm. Additional information appears on 38.

■ A.02

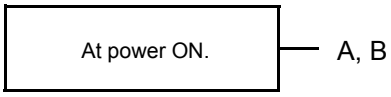
A.02: Parameter Breakdown

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Power turned OFF during parameter write. Alarm occurred at next power ON.	• Initialize parameters using Fn005 then reenter settings . • Replace the servo amplifier.
B	Circuit board (1PWB) defective.	Replace the servo amplifier.

■ A.03

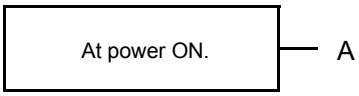
A.03: Main Circuit Detection Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Circuit board (1PWB or 2PWB) defective.	Replace servo amplifier.

■ A.04

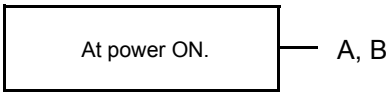
A.04: Parameter Setting Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state)

Status and Remedy for Alarm



Cause of the Problem		Solution
A	An out-of-range parameter was previously set or loaded.	• Reset all parameters in the range. • Otherwise, reload the correct parameter.
B	Circuit board (1PWB) is defective.	Replace the servo amplifier.

■ A.05

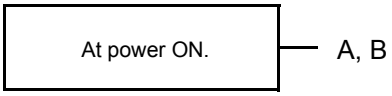
A.05: Servomotor and Amplifier Combination Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The range of servomotor capacities that can be combined has been exceeded.	Replace the servomotor so that an acceptable combination is achieved.
B	Encoder parameters have not been written properly.	Replace the servomotor.

■ A.10

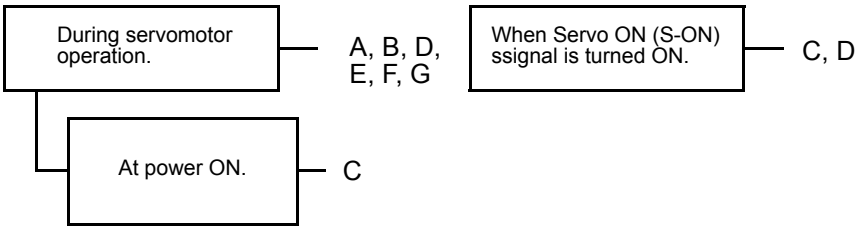
A.10: Overcurrent or Heat Sink Overheated

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Shorted wiring between servo amplifier and servomotor.	Check and correct wiring.
B	Shorted servomotor U, V, or W phase.	Replace servomotor.
C	• Defective circuit board (1PWB) . • Defective power transistor.	Replace servo amplifier.
D	Defective current feedback circuit, power transistor, DB circuit, or circuit board.	Replace servo amplifier.
E	Ambient temperature of the servo amplifier greater than 55°C.	Alter conditions so that the ambient temperature is below 55°C.
F	Inadequate air flow around the heat sink.	Providing sufficient space as specified.
G	Fan stopped.	Replace servo amplifier.
H	Servo amplifier is operating under an overload.	Reduce load.

Note: Problems E to H can occur in a servo amplifier with a capacity of 1.5 to 5kW, and all 400V models.

■ A.30

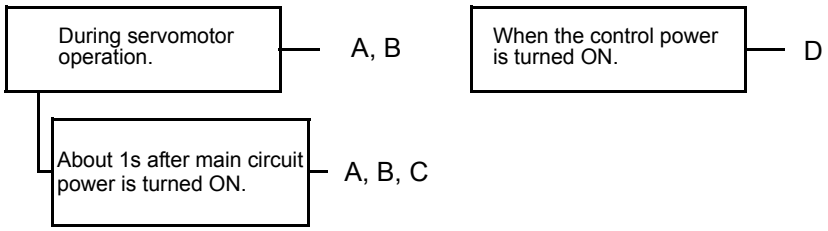
A.30: Regenerative Error Detected

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Malfunctioning regenerative transistor.	Replace servo amplifier.
B	Regenerative resistor is open.	Replace servo amplifier or regenerative resistor.
C	Disconnected regenerative unit (for an external regenerative resistor).	Check the wiring of the external regenerative resistor.
D	Defective servo amplifier.	Replace servo amplifier.

■ A.32

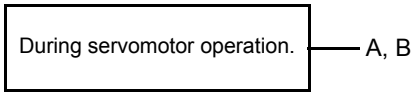
A.32: Regenerative Overload

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Regenerative power exceeds the limit.	Use an external regenerative resistor that matches the regenerative power capacity.
B	Alarm occurs although an external regenerative resistor is used and the temperature rise of the regenerative resistor is small.	Correct parameter Pn600.

■ A.40

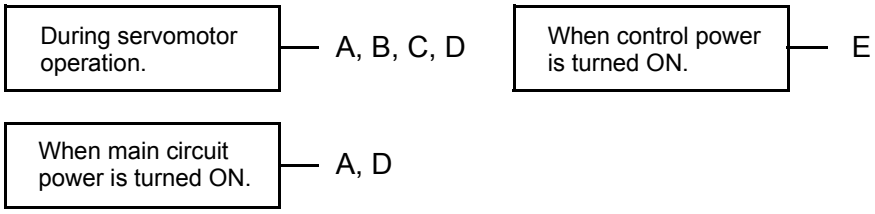
A.40: Main Circuit DC Voltage Error Detected: Overvoltage

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Power supply voltage is not within the range of specifications.	Check power supply.
B	Load exceeds capacity of the regenerative unit.	Check specifications of load inertia and overhanging load.
C	Malfunctioning regenerative transistor.	Replace servo amplifier.
D	Defective rectifying diode.	
E	Defective servo amplifier.	

■ A.41

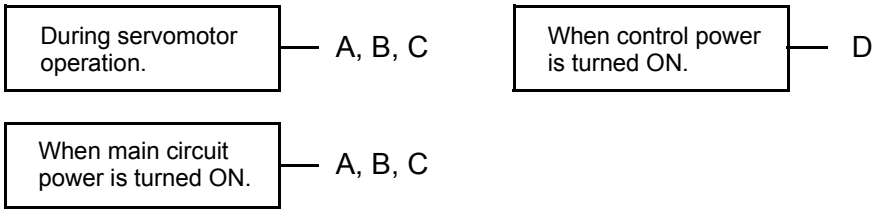
A.41: Main Circuit DC Voltage Error Detected: Undervoltage

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The power supply voltage exceeds specified range.	Check power supply voltage.
B	Fuse blown.	Replace servo amplifier.
C	Defective rectifying diode.	
D	Defective servo amplifier.	

■ A.51

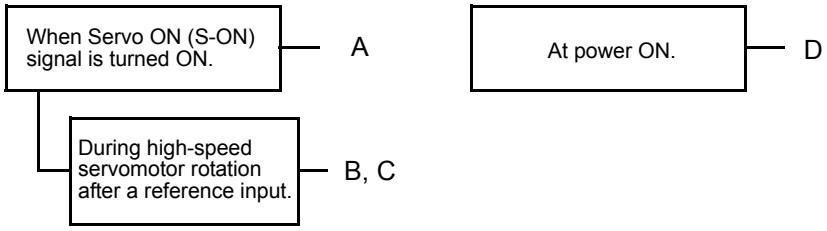
A.51: Overspeed

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrect servomotor wiring.	Check and correct wiring. (Check for U-, V-, and W-phase wiring errors.)
B	Position or speed reference input is too large.	Lower the reference input values.
C	Incorrect reference input gain settings.	Check and correct parameter settings.
D	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.71, A.72

A.71: Overload: High Load
A.72: Overload: Low Load.

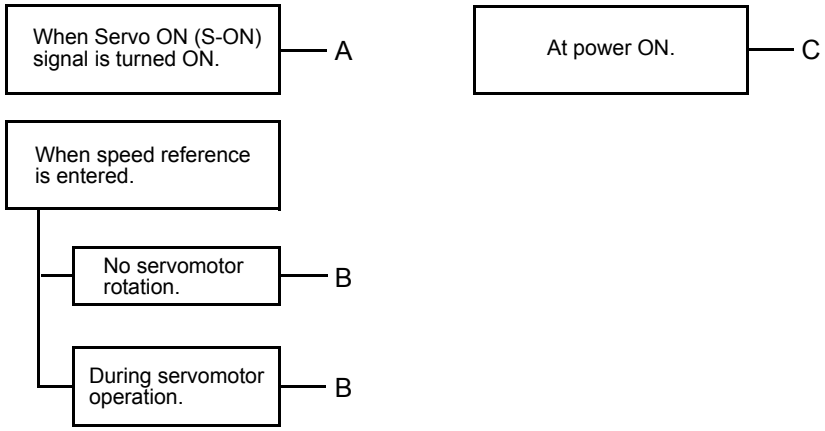
The alarm output, status, and remedy for A.71 are the same as for A.72.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm

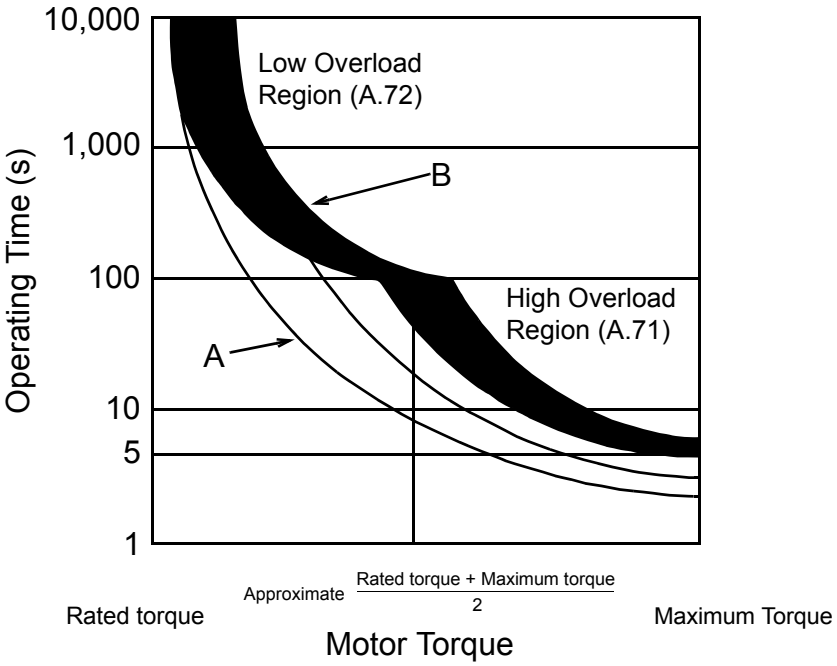


Cause of the Problem		Solution
A	Incorrect or disconnected servo-motor wiring.	Check wiring and connectors at the servomotor.
B	Load greatly exceeds rated torque.	Reduce load torque and inertia. Otherwise, replace with a larger capacity servomotor.
C	Defective circuit board (1PWB).	Replace servo amplifier.

Overload Characteristics

Servo amplifiers have a built-in overload protection function that protects the servo amplifiers and servomotors from overload. Allowable power for the servo amplifiers is limited by the overload protective function, as shown in the figure below.

The overload detection level is set under hot start conditions at a servomotor ambient temperature of 40°C.



Note: The overload protection characteristics of A and B in the figure are applicable when the servo amplifier is combined with one of the following servomotors:

A: SGMAH or SGMPH servomotor with a maximum capacity of 400W, 100V and 200V only.

B: Other servomotors similar to the SGMAH, SGMPH, SGMGH, SGMSH, and SGMUH.

■ A.73

A.73: Dynamic Brake Overload

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm

When the Servo OFF (/S-ON) signal is turned ON. — A

At power ON. — B

Cause of the Problem		Solution
A	The product of the square of rotational motor speed, the combined inertia of the motor, and load (rotation energy) exceeds the capacity of the dynamic brake resistor built into servo amplifier.	• Reduce the rotational speed. • Decrease the load inertia. • Minimize use of the dynamic brake.
B	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.74

A.74: Overload of Surge Current Limit Resistor

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm

Cause of the Problem		Solution
A	Frequently turning the main circuit power ON/OFF.	Do not repeatedly turn ON/OFF the main circuit power.
B	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.7A

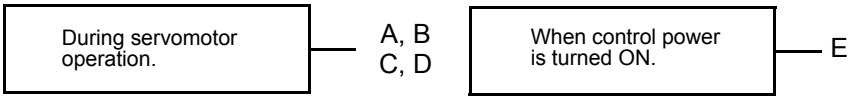
A.7A: Heat Sink Overheated
Heat sink temperature exceeds 100°C.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The ambient temperature of the servo amplifier exceeds 55°C.	Alter conditions so that the ambient temperature goes below 55°C.
B	Inadequate air flow around the heat sink .	Provide sufficient space as specified.
C	Fan stopped.	Replace servo amplifier.
D	Servo amplifier is operating under overload.	Reduce load.
E	Defective servo amplifier.	Replace servo amplifier.

Note: Larger servo amplifiers (1.5kW., or larger) will display alarm A.10 if the heat sink overheats.

■ A.81

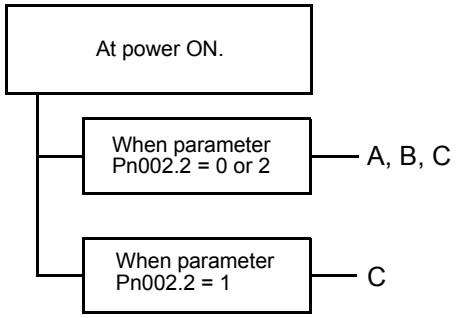
A.81: Absolute Encoder Backup Power Supply Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The following power supplies to the absolute encoder both failed: • +5V supply • Battery power	Follow absolute encoder setup procedure.
B	Absolute encoder malfunctioned.	Replace servomotor.
C	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.82

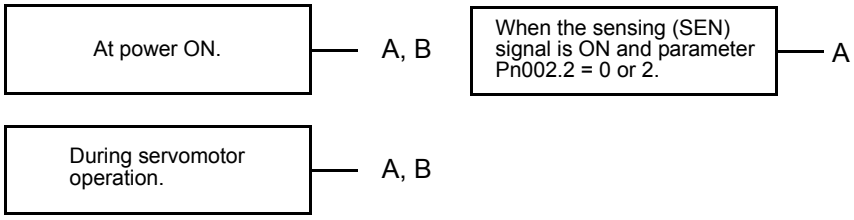
A.82: Encoder Checksum Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Error during encoder memory check.	• Follow absolute encoder setup procedure. • Replace servomotor if error occurs frequently.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.83

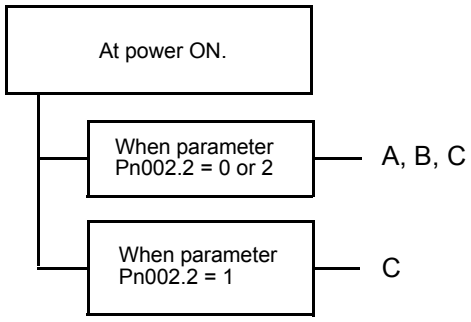
A.83: Absolute Encoder Battery Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	• Disconnected battery. • Defective battery connection.	Check and correct battery connection.
B	Battery voltage below specified value. Specified value: 2.7V.	Install a new battery while the control power to the servo amplifier is ON. After replacement, cycle the power OFF and ON again.
C	Defective circuit board (1PWB).	Replace servo amplifier.*

* The replacement procedure is described in *Section 9.1.3 Replacing the Battery for the Absolute Encoder*

Note: No alarm will occur at the servo amplifier if the battery error occurs during operation.

■ A.84

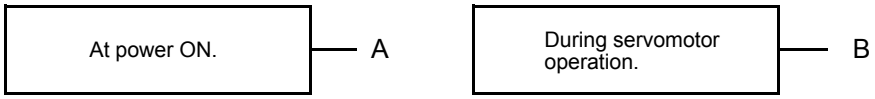
A.84: Absolute Encoder Data Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Malfunctioning absolute encoder.	Replace servomotor if error occurs frequently.
B	Operational error in encoder caused by external noise	Check and correct wiring around the encoder, (grounding of servomotor, separation of encoder and power cables, insertion of toroidal cores onto cables to reduce noise, etc.)

■ A.85

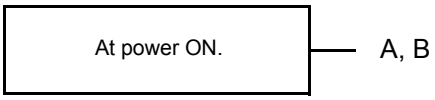
A.85: Absolute Encoder Overspeed

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Not: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Absolute encoder turned ON at motor speed exceeding 200rpm.	Turn ON power supply with the servomotor stopped.
B	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.86

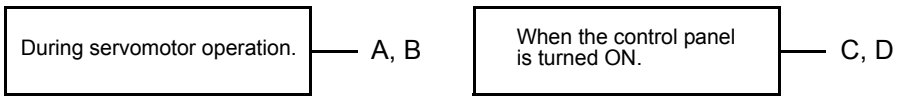
A.86: Encoder Overheated

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm



Cause of the Problem		Solution
A	The ambient temperature of the servomotor is high.	Alter conditions so that the ambient temperature goes below 40°C
B	Servomotor is operating under overload.	Reduce load.
C	Circuit board (1PWB) defective.	Replace servo amplifier.
D	Encoder defective.	Replace servo amplifier.

■ A.b1, A.b2

A.b1: Reference Speed Input Read Error

A.b2: Reference Torque Input Read Error

The alarm output, status, and remedy for A.b1 are the same as for A.b2.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).

Status and Remedy for Alarm

During servomotor operation. — A, B

At power ON. — A, B, C

Cause of the Problem		Solution
A	Error in reference read-in unit (A/D Converter, etc.).	Reset alarm and restart operation.
B	Faulty reference read-in unit (A/D Converter, etc.).	Replace servo amplifier.
C	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.C1

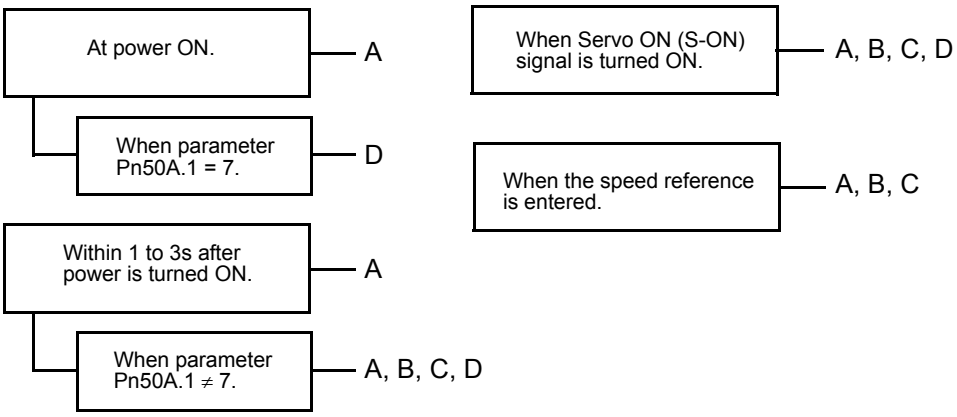
A.C1: Servo Run Away

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm


At power ON.
A
When parameter Pn50A.1 = 7.
D
Within 1 to 3s after power is turned ON.
A
When parameter Pn50A.1 ≠ 7.
A, B, C, D
When Servo ON (S-ON) signal is turned ON.
A, B, C, D
When the speed reference is entered.
A, B, C

Cause of the Problem		Solution
A	Incorrect or disconnected servomotor wiring.	Check wiring and connectors at the servomotor.
B	Incorrect or disconnected encoder wiring.	Check wiring and connectors at the encoder.
C	Defective encoder.	Replace servomotor.
D	Defective circuit board (1PWB).	Replace servo amplifier.

■ A.C8

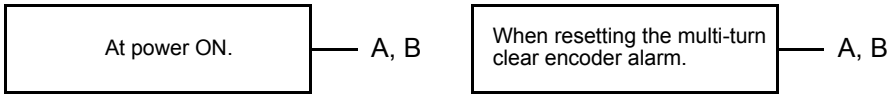
A.C8: Absolute Encoder Clear Error and Multi-turn Limit Setting Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Encoder defective.	Replace servomotor.
B	Servo amplifier defective.	Replace servo amplifier.

■ A.C9

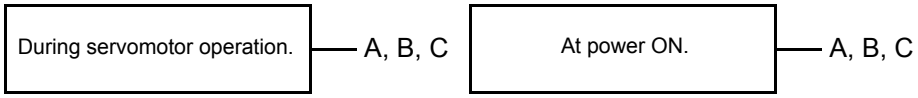
A.C9: Encoder Communications Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrect or disconnected encoder wiring.	Check wiring and connectors at the encoder.
B	Defective encoder.	Replace servomotor.
C	Defective servo amplifier.	Replace servo amplifier.
D	Excessinve vibration/shock to motor.	Reduce vibration/shock

■ A.CA

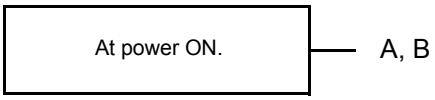
A.CA: Encoder Parameter Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Defective encoder.	Replace servomotor.
B	Defective servo amplifier.	Replace servo amplifier.

■ A.Cb

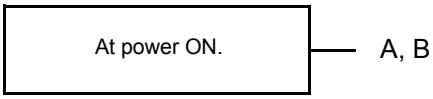
A.Cb: Encoder Echoback Error

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrect or disconnected encoder wiring.	Check wiring and connectors at encoder.
B	Defective encoder.	Replace servomotor.
C	Defective servo amplifier.	Replace servo amplifier.

■ A.CC

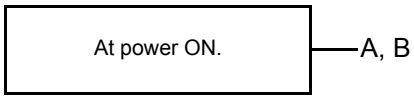
A.CC: Multi-turn Limit Disagreement Alarm

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	OFF	ON	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Incorrectly set Multi-Turn Limit Setting parameter (Pn205) in the servo amplifier.	Change the value in parameter Pn205.
B	No Multi-Turn Limit value set in the encoder.	First verify that the Multi-Turn Limit Setting parameter (Pn205) is set correctly in the servo amplifier. While in the active alarm state, change the setting in the encoder Multi-Turn Limit Setting parameter (Pn205) using function Fn013.

■ A.d0

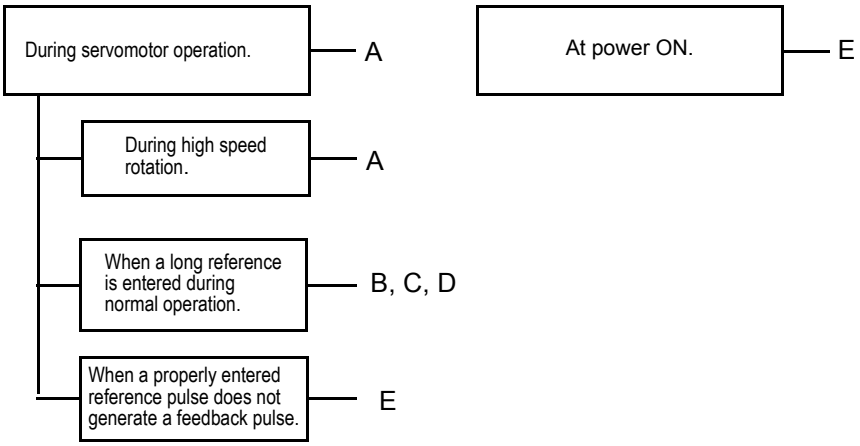
A.d0: Position Error Pulse Overflow

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	Servomotor wiring incorrect or poor connection	Check wiring and connectors at encoder.
B	Servo amplifier was not correctly adjusted.	Increase speed loop gain (Pn100) and position loop gain (Pn102).
C	Motor load was excessive.	Reduce load torque or inertia. If problem persists, replace with a larger capacity motor.
D	Position reference pulse frequency was too high.	•Increase or decrease reference pulse frequency. •Add smoothing function. •Correct electronic gear ratio.
E	Circuit board (1PWB) defective.	Replace servo amplifier.

■ A.E7

A.E7: Option Unit Detection Error

A.E7 occurs the first time the SGDH amplifier is used after disconnecting an option unit. This alarm cannot be cleared with an alarm reset; instead, clear it with function Fn014.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
ON	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm

When the control power is turned ON after disconnecting an option unit — A

When the control power is turned ON with an option unit connected. — B, C, D

Cause of the Problem		Solution
A	The SGDH amplifier is used immediately after disconnection of an option unit without clearing the unit detector.	To use the SGDH amplifier after disconnecting the option unit, execute Fn014 (option unit detection result clear), in the auxiliary function mode, and then cycle the power.
B	Option unit connection is defective.	Check and correct the connection.
C	Option unit is defective.	Replace the option unit.
D	Servo amplifier	Replace the servo amplifier.

■ A.F1

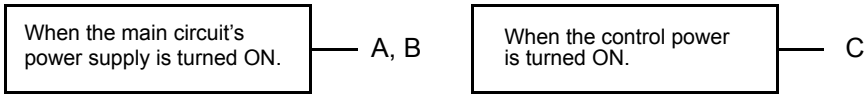
A.F1: Power Line Open Phase

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	ON	OFF	OFF

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

Status and Remedy for Alarm



Cause of the Problem		Solution
A	One phase (L1, L2, or L3) of the main circuit power supply is disconnected.	• Check power supply. • Check wiring of the main circuit power supply. • Check MCCB, noise filter, magnetic contactor.
B	There is one phase where the line voltage is low.	Check power supply.
C	Servo amplifier defective.	Replace servo amplifier.

Note: A and B tend to occur in a servo amplifier with a capacity of 500W or higher.

■ CPF00

CPF00: Digital Operator Transmission Error 1

This alarm is not stored in the alarm history.

The watch dog timer time dout due to an excessively long command associated with the application module (e.g. JUSP NS300). In such cases the amplifier will recover automatically.

Display and Outputs

<table>
<tr><td colspan="4">Alarm Outputs</td></tr>
<tr><td colspan="3">Alarm Code Output</td><td rowspan="2">ALM Output</td></tr>
<tr><td>ALO1</td><td>ALO2</td><td>ALO3</td></tr>
<tr><td colspan="4">Not Applicable</td></tr>
</table>

Status and Remedy for Alarm

When the digital operator is connected before or after the servo amplifier has been turned ON.	A, B C, D

Cause of the Problem		Solution
A	Cable defective or poor contact between digital operator and servo amplifier.	• Check connector connections. • Replace cable.
B	Malfunction due to external noise.	Separate digital operator and cable from noise source.
C	Digital operator defective.	Replace digital operator.
D	Servo amplifier defective.	Replace servo amplifier.

■ CPF01

CPF01: Digital Operator Transmission Error 2

This alarm is not stored in the alarm history.

Display and Outputs

<table>
<tr><td colspan="4">Alarm Outputs</td></tr>
<tr><td colspan="3">Alarm Code Output</td><td rowspan="2">ALM Output</td></tr>
<tr><td>ALO1</td><td>ALO2</td><td>ALO3</td></tr>
<tr><td colspan="4">Not Applicable</td></tr>
</table>

Status and Remedy for Alarm

During servomotor operation. — A, B, C, D

Cause of the Problem		Solution
A	Cable defective or poor contact between digital operator and servo amplifier.	• Check connector connections. • Replace cable.
B	Malfunction due to external noise	Separate digital operator and cable from noise source.
C	Digital operator defective.	Replace digital operator.
D	Servo amplifier defective.	Replace servo amplifier.

■ A.- -

A.- -: Normal Operation

This is not an alarm display.

Display and Outputs

Alarm Outputs			
Alarm Code Output			ALM Output
ALO1	ALO2	ALO3	
OFF	OFF	OFF	ON

Note: OFF: Output transistor is OFF (alarm state).
ON: Output transistor is ON.

9.2.2 Troubleshooting Problems with No Alarm Display

Use the tables below to identify the cause of a problem that causes no alarm display and follow the described corrective procedure.

Turn OFF the servo system power supply before starting the shaded procedures.

Contact Yaskawa if the problem cannot be solved by carefully following the described procedure.

Troubleshooting Table No Alarm Display

Symptom	Cause	Comment	Solution
Servomotor does not start	Power not connected	Check voltage between power supply terminals.	Correct the power circuit.
	Loose connection	Check terminals of connectors (CN1, CN2).	Tighten any loose parts.
	Connector (CN1) external wiring incorrect	Check connector (CN1) external wiring	Refer to connection diagram and correct wiring.
	Servomotor or encoder wiring disconnected.	—	Reconnect wiring
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	No speed/position references input	Check reference input pins.	Correctly input speed/position references.
	/S-ON is turned OFF	Check settings of parameters Pn50A.0 and Pn50A.1.	Turn /S-ON input ON.
	/P-CON input function setting incorrect	Check parameter Pn000.1.	Refer to section *5.3.5* and set parameters to match application.
	Reference pulse mode selection incorrect.	Refer to section *5.2.2*	Correct setting of parameter Pn200.0.
	Encoder type differs from parameter setting.	Confirm whether incremental or absolute encoder is used.	Set parameter Pn002.2 to the encoder type being used.
	P-OT and N-OT inputs are turned OFF.	Refer to section *5.1.2*.	Turn P-OT and N-OT input signals ON.
	CLR input is turned ON	Check status of error counter clear input.	Turn CLR input OFF.
	SEN input is turned OFF.	When absolute encoder is used.	Turn SEN input ON.
Servomotor moves suddenly, then stops	Servomotor or encoder wiring incorrect.	—	Refer to chapter 3 and correct wiring.
Suddenly stops during operation and will not restart	Alarm reset signal (/ALM-RST) is turned ON because an alarm occurred	—	Remove cause of alarm. Turn alarm reset signal (ALM-RST) from ON to OFF.
Unstable servomotor speed.	Defective wiring connection to the motor.	Check the connections of the power lead (U-, V-, and W-phases) and the encoder connectors.	Tighten any loose terminals or connectors

Symptom	Cause	Comment	Solution
Servomotor vibrates at approximately 200 to 400Hz.	Speed loop gain value too high.	—	Reduce speed loop gain (Pn100) preset value.
	Speed/position reference input wire too long.	—	Minimize length of speed/position reference input wire, with impedance not exceeding several hundred ohms
	Speed/position reference input wire is bundled with power cables.	—	Separate reference input wire at least 30cm from power cables.

Symptom	Cause	Comment	Solution
High rotation speed overshoot on starting and stopping.	Speed loop gain value too high.	—	Reduce speed loop gain (Pn100) preset value. Increase integration time constant (Pn101).
	Speed loop gain is too low compared to position loop gain.	—	Increase the value of parameter Pn100 (speed loop gain). Reduce the integration time constant (Pn101).
Servomotor overheated	Ambient temperature too high	Measure servomotor ambient temperature.	Reduce ambient temperature to 40°C maximum.
	Servomotor surface dirty	Visual check	Clean dust and oil from motor surface.
	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
Abnormal noise	Incorrect mechanical mounting	Servomotor mounting screws loose?	Tighten mounting screws.
		Coupling not centered?	Center coupling.
		Coupling unbalanced?	Balance coupling.
	Bearing defective	Check noise and vibration near bearing.	Consult your Yaskawa representative if defective.
	Machine causing vibrations	Foreign object intrusion, damage, or deformation of sliding parts of machine.	Consult with machine manufacturer.
Speed reference 0V but servomotor rotates.	Speed reference voltage offset applied	—	Adjust reference offset. Refer to sections *7.2.4* and *7.2.5*

9.2.3 Alarm Display Table

A summary of alarm displays and alarm code outputs is given in the following table.

Alarm Display Table

Alarm Display	Alarm Code Output			ALM Output	Alarm Name	Description
	ALO1	ALO2	ALO3			
A.02	OFF	OFF	OFF	OFF	Parameter Breakdown*1	EEPROM data of servo amplifier is abnormal.
A.03					Main Circuit Detection Error	Detection data for power circuit is abnormal.
A.04					Parameter Setting Error*1	The parameter setting is outside the allowable setting range.
A.05					Servomotor and Amplifier Combination Error	Servo amplifier and servomotor capacities do not match each other.
A.10	ON	OFF	OFF	OFF	Overcurrent or Heat Sink Overheated**	An overcurrent flowed through the IGBT. Heat sink of servo amplifier was overheated.
A.30	ON	ON	OFF	OFF	Regeneration Error Detected	• Regenerative circuit is faulty • Regenerative resistor is faulty.
A.32					Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.
A.40	OFF	OFF	ON	OFF	Overvoltage	Main circuit DC voltage is excessively high.
A.41					Undervoltage	Main circuit DC voltage is excessively low.
A.51	ON	OFF	ON	OFF	Overspeed	Rotational speed of the motor is excessively high.
A.71	ON	ON	ON	OFF	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.
A.72					Overload: Low Load	The motor was operating continuously under a torque exceeding ratings
A.73					Dynamic Brake Overload	When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.
A.74					Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.
A.7A					Heat Sink Overheated 2)	The heat sink of servo amplifier overheated.

*1 **These alarms are not reset by the alarm reset signal (/ALM-RST). Eliminate the cause of the alarm and then turn OFF the power supply to reset the alarms.**

2) This alarm display appears only within the range of 30W to 1kW.

Notes: OFF: Output transistor is OFF.
ON: Output transistor is ON.

Alarm Display	Alarm Code Output			ALM Output	Alarm Name	Description
	ALO1	ALO2	ALO3			
A.81	OFF	OFF	OFF	OFF	Absolute Encoder Backup Error*	All the power supplies for the absolute encoder have failed and position data was cleared.
A.82					Encoder Checksum Error*	The checksum results of encoder memory is abnormal.
A.83					Absolute Encoder Battery Error	Battery voltage for the absolute encoder has dropped.
A.84					Absolute Encoder Data Error*	Received absolute data is abnormal.
A.85					Absolute Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.
A.86					Encoder Overheated	The internal temperature of encoder is too high.
A.b1					Reference Speed Input Read Error	The A/D converter for reference speed input is faulty.
A.b2					Reference Torque Input Read Error	The A/D converter for reference torque input is faulty.
A.bF					System Alarm*	A system error occurred in the servo amplifier.
A.C1	ON	OFF	ON	OFF	Servo Overrun Detected	The servomotor ran out of control.
A.C8					Absolute Encoder Clear Error and Multi-Turn Limit Setting Error*	The multi-turn for the absolute encoder was not properly cleared or set.
A.C9					Encoder Communications Error*1	Communications between servo amplifier and encoder is not possible.
A.CA					Encoder Parameter Error*1	Encoder parameters are faulty.
A.Cb					Encoder Echoback Error*1	Contents of communications with encoder is incorrect.
A.CC	ON	OFF	ON	OFF	Multi-Turn Limit Disagreement	Different multi-turn limits have been set in the encoder and servo amplifier.
A.d0	ON	ON	OFF	OFF	Position Error Pulse Overflow	Position error pulse exceeded parameter (Pn505).
A.E7	OFF	ON	ON	OFF	Option Unit Detection Error	Option unit detection fails.
A.F1	OFF	ON	OFF	OFF	Power Line Open Phase	One phase is not connected in the main power supply
CPF00	Not Specified				Digital Operator Transmission Error	Digital operator (JUSP-OP02A-2) fails to communicate with servo amplifier (e.g., CPU error).
CPF01						
A.--	OFF	OFF	OFF	ON	Not an error	Normal operation status

*1 **These alarms are not reset by the alarm reset signal (/ALM-RST). Eliminate the cause of the alarm and then turn OFF the power supply to reset the alarms.**

2) This alarm display appears only within the range of 30 to 1000W.

Notes: OFF: Output transistor is OFF.
ON: Output transistor is ON.

9.2.4 List of Additional or Modified Alarm and Warning Displays (Applicable only to SGDH amplifiers with version # 33□□□ or higher)

Alarms

Alarm Display	Alarm Code Output			Servo Alarm (ALM) Output	Alarm Name	Cause	Alarm Reset *1	Corrective Actions
	ALO1	ALO2	ALO3					
A.09	×	×	×	×	Dividing ratio setting error	The setting of dividing ratio (Pn212) is not acceptable (out of fixed increments), or exceeds the value for the connected encoder resolution.	Not available	Correct the setting of Pn212, and turn OFF the control power and turn it ON again.
						When a linear motor is connected: A value higher than the allowable maximum dividing ration calculated on the base of the linear motor maximum speed was set in Pn281.	Not available	Check Un010, and correct the setting. Turn OFF the control power and turn it ON again to enable the new setting.
A.0A	×	×	×	×	Encoder model unmatched	The mounted serial encoder is not supported by Σ-II series servo amplifier.	Not available	Replace the servomotor with Σ-II series servo amplifier supported model.
A.55	○	×	○	×	Linear motors Max. speed setting error	When a linear motor is connected A value higher than the linear motor maximum speed is set in Pn384.	Available	Reduce the setting in Pn384 to the linear motor maximum speed or less.
A.b3	×	×	×	×	Current detection error	The current sensor is faulty, or the servomotor is disconnected.	Available	Check the servomotor power line wiring Replace the servo amplifier.
A.F5 A.F6	×	○	×	×	Servomotor disconnection alarm	The detected toque is 10% or less, but the commanded torque reference is 90% or more for 10ms. This alarm is not activated in cases of BB due to hardware issues. In those cases, an A.F6 or A.b3 is generated instead.	Available	Check the servomotor power line wiring. Replace the servo amplifier.

*1: Indicates whether the alarm can be reset or not after having removed the cause of alarm.

9.2.5 Warning Displays

The correlation between warning displays and warning code outputs is shown in the following table.

Warning Displays and Outputs

Warning Display	Warning Code Outputs			Warning Name	Meaning of Warning
	ALO1	ALO2	ALO3		
A.91	ON	OFF	OFF	Overload	This warning occurs before either of the overload alarms (A.71 or A.72) occurs. If the warning is ignored and operation continues, an overload alarm may result.
A.92	OFF	ON	OFF	Regenerative Overload	This warning occurs before the regenerative overload alarm (A.32) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may result.

Warnings (Additional Warning Display) (Applicable only to SGDH amplifiers with version # 33□□□ or higher)

Warning Display	Warning Code Output			Warning Name	Cause	Corrective Actions
	ALO1	ALO2	ALO3			
A.90	×	×	×	Excessive position error warning	The position errors exceed the setting in Pn51E.	Reduce the position errors to the value of Pn51E or less to restore automatically.

9.2.6 Additional Sigma II Alarms

Alarm Code	Descriptions
A.08	Linear scale pitch setting error.
A.33	Wrong input power. Amplifier is in AC input mode (Pn001.2=0), but has DC input; or vice versa
A.76	Pre-charge contactor failure. Pre-charge contactor failed to close when SVON signal is applied. Applicable to large capacity (22-55kW) amplifiers only.
A.C2	Encoder output phase error. Applicable to linear scale only
A.C5	Linear motor Hall sensor position detection error.
A.F4	Magnetic contactor for Soft-Charge not closed after 500ms of PowerON. (Applicable to large capacity drives only)

Alarm with Intelligent Option Boards (MP940, etc.) :

A.D1	Full-Closed Loop (FC100): FC encoder and motor encoder pulses discrepancy too large. Check Pn206
A.E0	Option board not connected/no response. At power on, the SGDH will check for 10 seconds if the option board is connected. Check Pn004, it should be 0000.
A.E1	Option board timed out. Timer in SGDH starts timing when control board function starts. Timer currently is set for 10 sec.
A.E2	Watch Dog Timer alarm. Option board and SGDH are out of synchronism.
A.E5	MECHATROLINK synchronization error.
A.E6	MECHATROLINK communication error (failed twice consecutively).
A.E7	Option board not connected. After power on with option board connected, the option board is removed while power is still on. Reset alarm with Fn014.

The following Alarms are generated by Option Boards:

A.93	Low absolute encoder battery (NS600)
A.94	Data set up warning. Invalid or out of range data.
A.95	Invalid command warning. Inappropriate command was issued for the current control state.
A.9F	I/O cable not connected (MP940 or MECHATROLINK cable disconnected).
A.b6	Option board (JL-040) abnormal.
A.E9	MP940 alarm. This alarm is generated by the MP940 when there is problem in the MP940. Check MP940 for more information.
A.EA	SGDH does not respond at power on or after reset.
A.Eb	SGDH initial access error. SGDH Power on start up confirmed, but response is absent or faulty.
A.EC	Watch Dog Timer error. SGDH ran away or WDT abnormal.
A.ED	Command execution incomplete.
A.EF	Controller Alarm

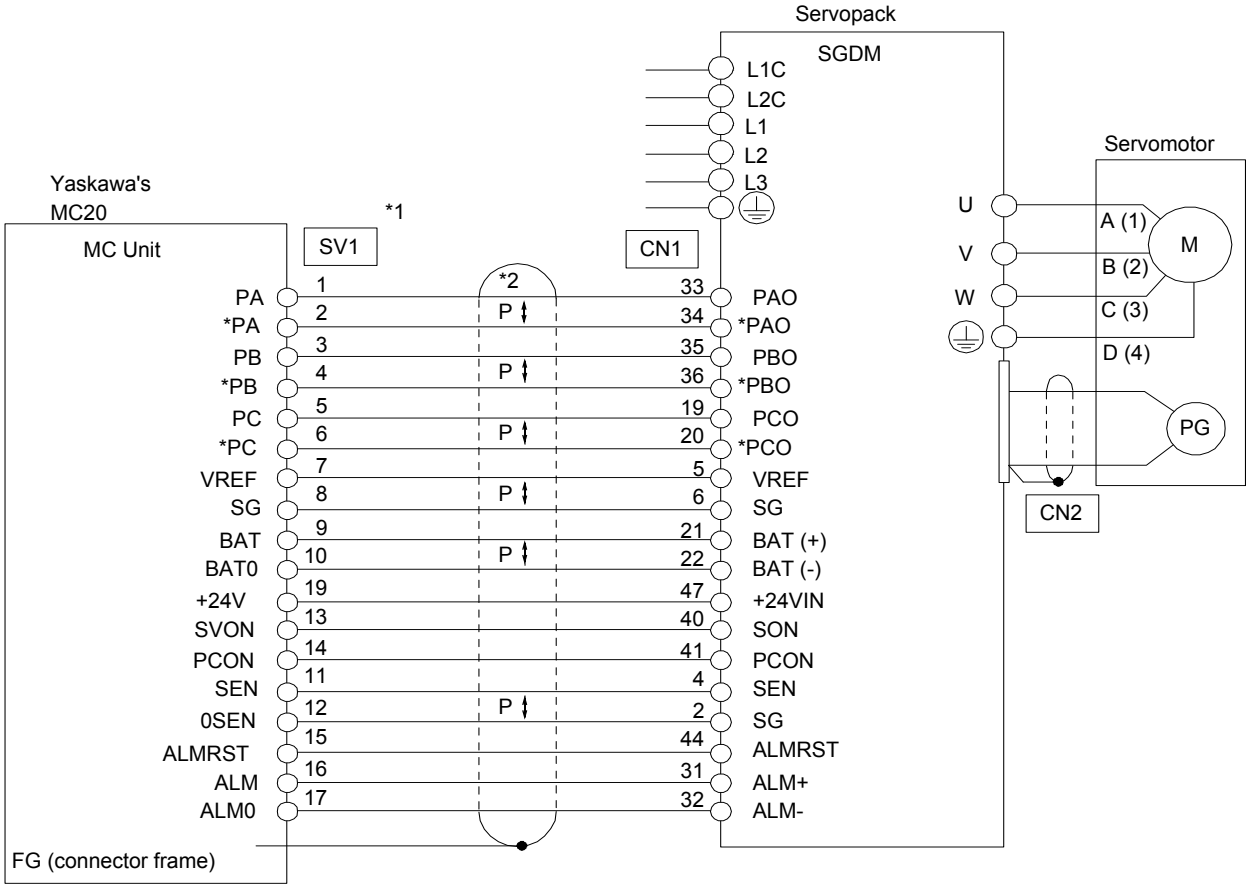
A Host Controller Connection Examples

This appendix provides examples SGDH servo amplifiers connected to typical host controllers. Refer to the manuals for the host controller when actually connecting to them.

A.1 Connecting the GL-series MC20 Motion Module A-2
A.2 Connecting the CP-9200SH Servo Controller Module (SVA) A-3
A.3 Connecting the GL-series B2813 Positioning Module A-4
A.4 Connecting OMRON's C500-NC221 Position Control Unit A-5
A.5 Connecting OMRON's C500-NC112 Position Control Unit A-6
A.6 Connecting MITSUBISHI's AD72 Positioning Unit A-7
A.7 Connecting MITSUBISHI's AD75 Positioning Unit A-8

A.1 Connecting the GL-series MC20 Motion Module

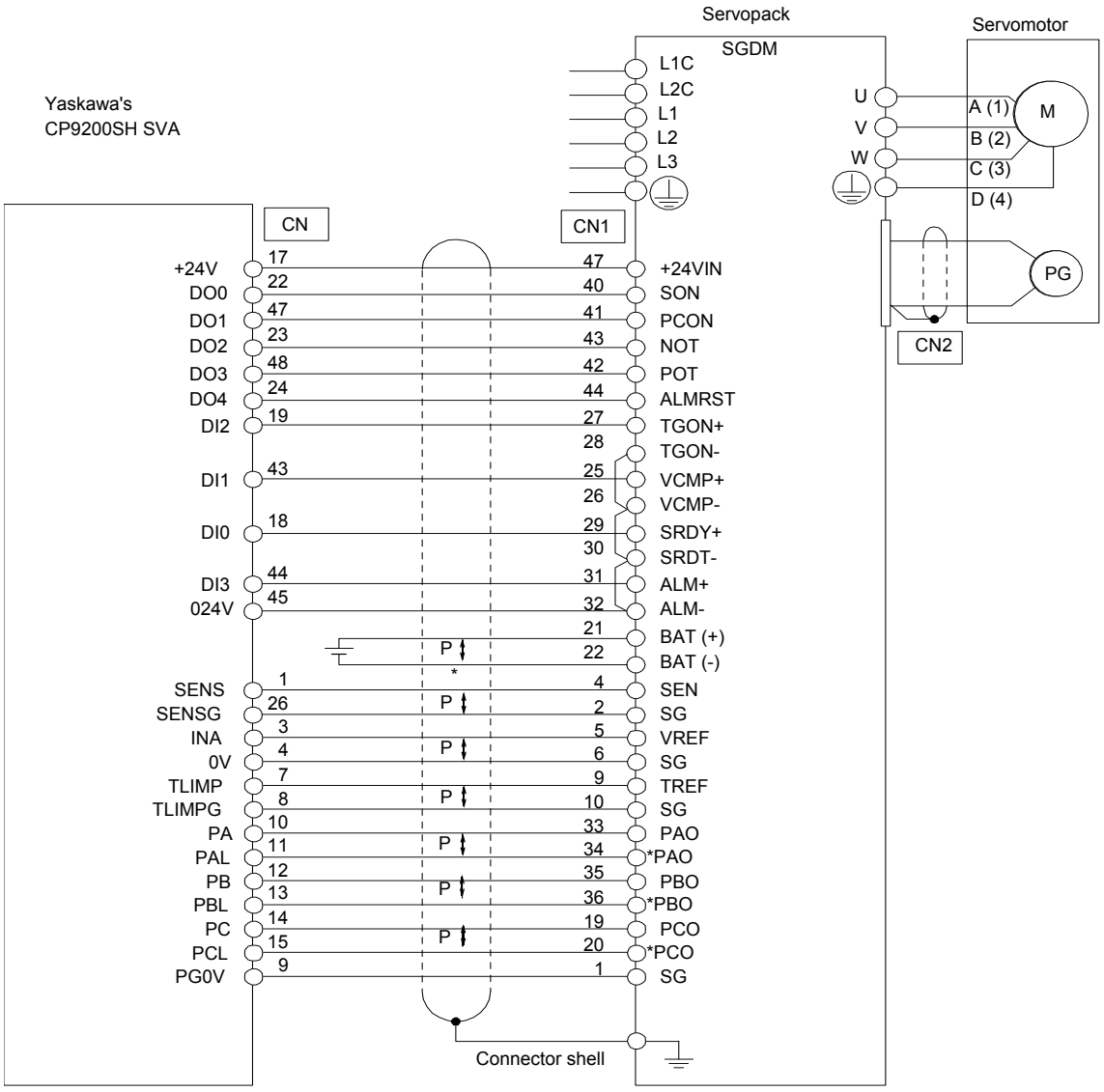
The following diagram shows an example of connecting to the GL-series MC20 Motion Module. In this example, the servo amplifier is used in Speed Control Mode.



. These pin numbers are the same for SV2 to SV4.
. P Indicates twisted pair wires.

A.2 Connecting the CP-9200SH Servo Controller Module (SVA)

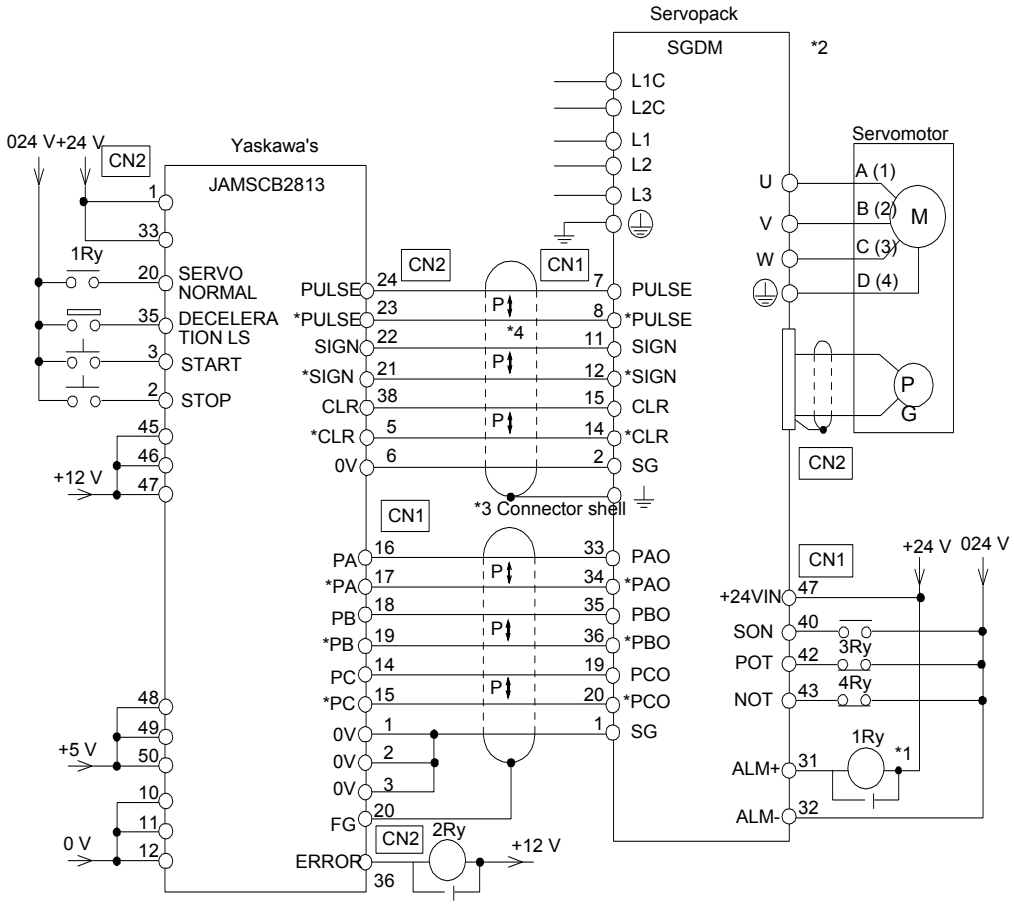
The following diagram shows an example of connecting to the CP-9200SH servo controller Module (SVA). In this example, the servo amplifier is used in Speed Control Mode.



P Indicates twisted pair wires.

A.3 Connecting the GL-series B2813 Positioning Module

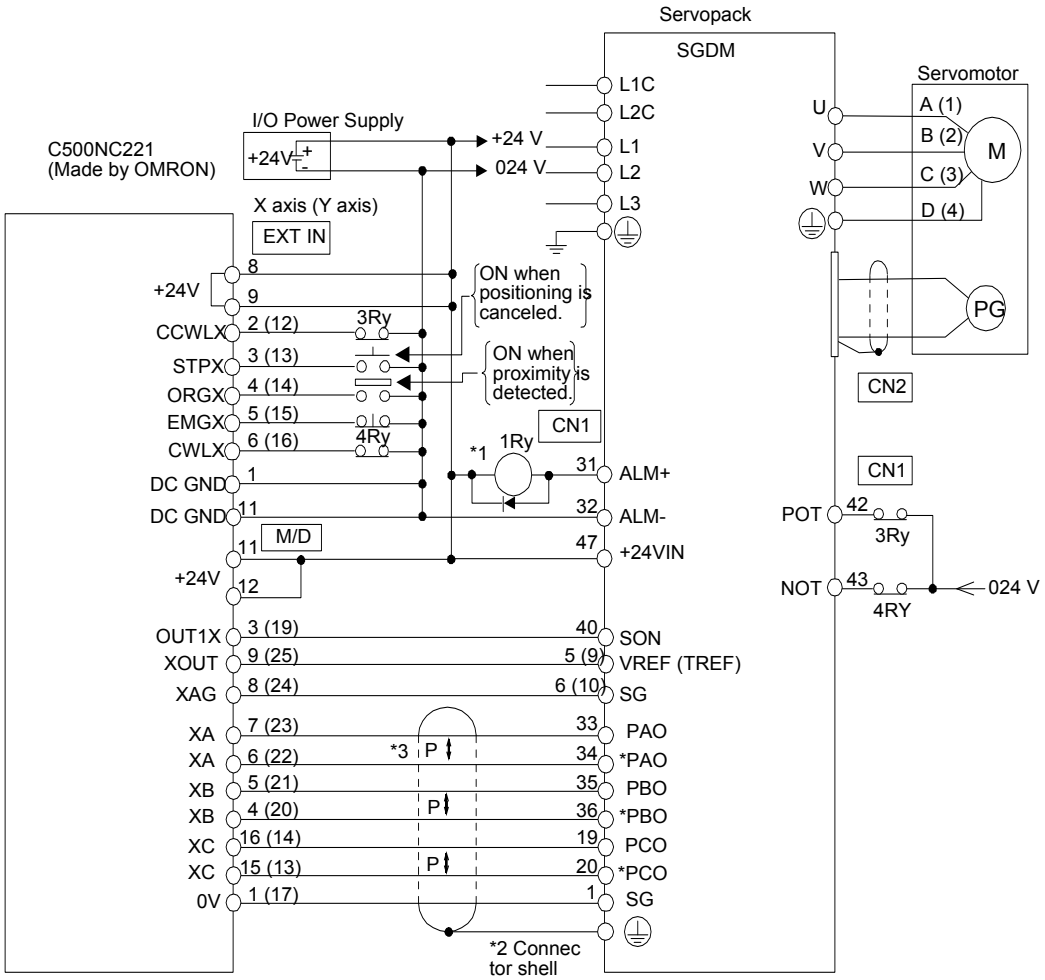
The following diagram shows an example of connecting to the GL-series B2813 Positioning Module. In this example, the servo amplifier is used in Position Control Mode.



*1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the servopack.
*2. Set user parameter Pn200.0 to 1.
*3. Connect the shield wire to the connector shell.
*. P↕ indicates twisted pair wires.

A.4 Connecting OMRON's C500-NC221 Position Control Unit

The following diagram shows an example of connecting to an OMRON C500-NC221 Position Control Unit. In this example, the servo amplifier is used in Speed Control Mode.



*1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the servopack.

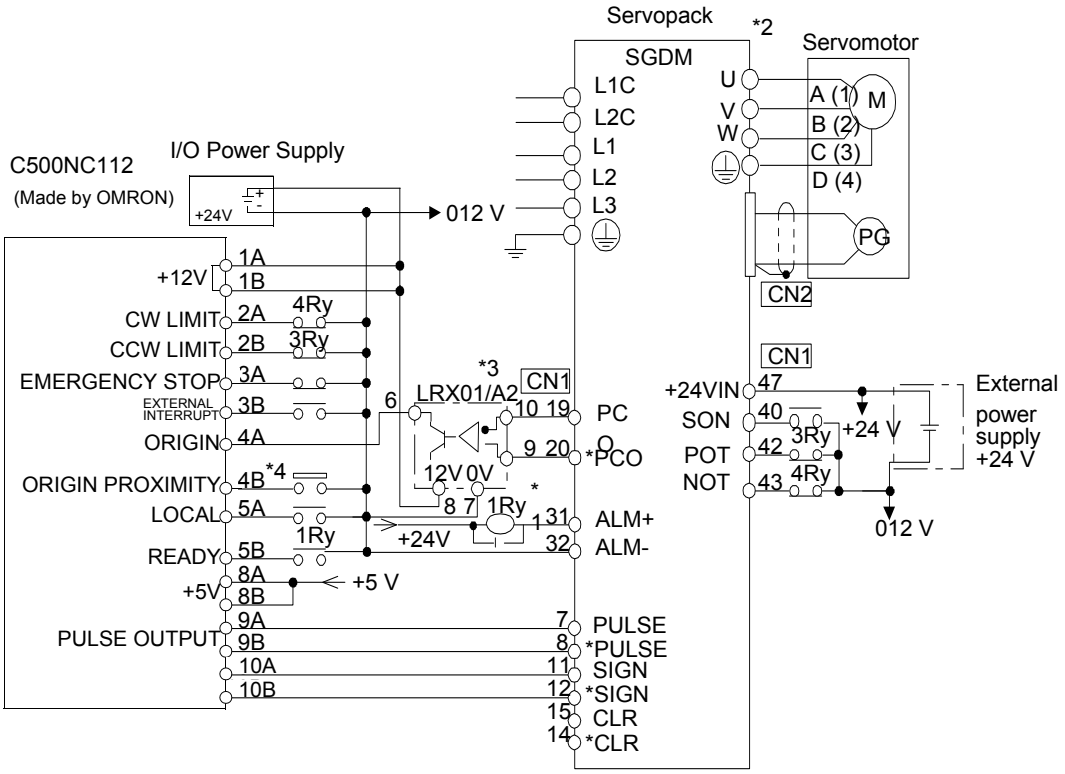
*2. Connect the shield wire to the connector shell.

*. P indicates twisted pair wires.

Note Only signals applicable to OMRON's C500NC221 Position Control Unit and Yaskawa's SGDM servo amplifier are shown here.

A.5 Connecting OMRON's C500-NC112 Position Control Unit

The following diagram shows an example of connecting to the OMRON C500-NC112 Position Con trol Unit. In this example, the servo amplifier is used in the position control mode.



*1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the servopack.

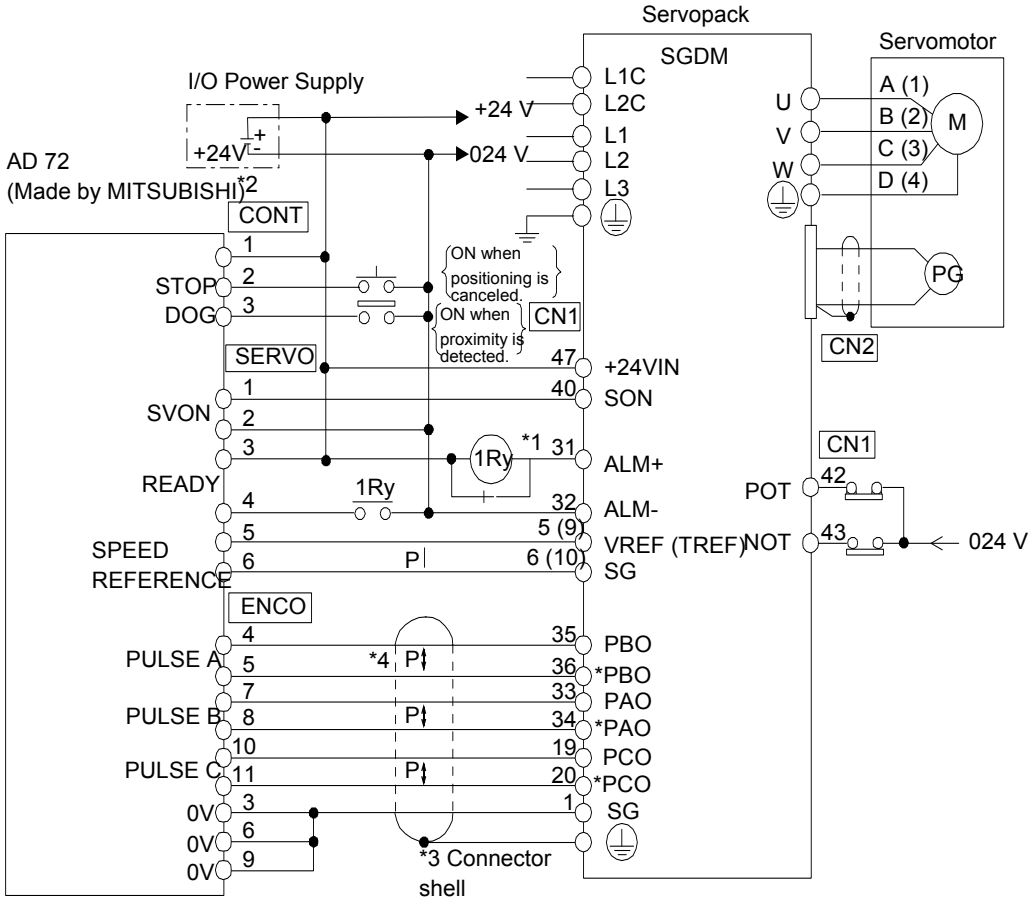
*2. Set the user parameter Pn200.0 to 1.

*3. Manufactured by Yaskawa Controls Co.

Note Only signals applicable to OMRON's C500NC112 Position Control Unit and Yaskawa's SGDM servo amplifier are shown here.

A.6 Connecting MITSUBISHI's AD72 Positioning Unit

The following diagram shows an example of connecting to the MITSUBISHI AD72 Positioning Unit. In this example, the servo amplifier is used in Speed Control Mode.



*1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the servopack.

*2. Pin numbers are the same for both the X axis and the Y axis.

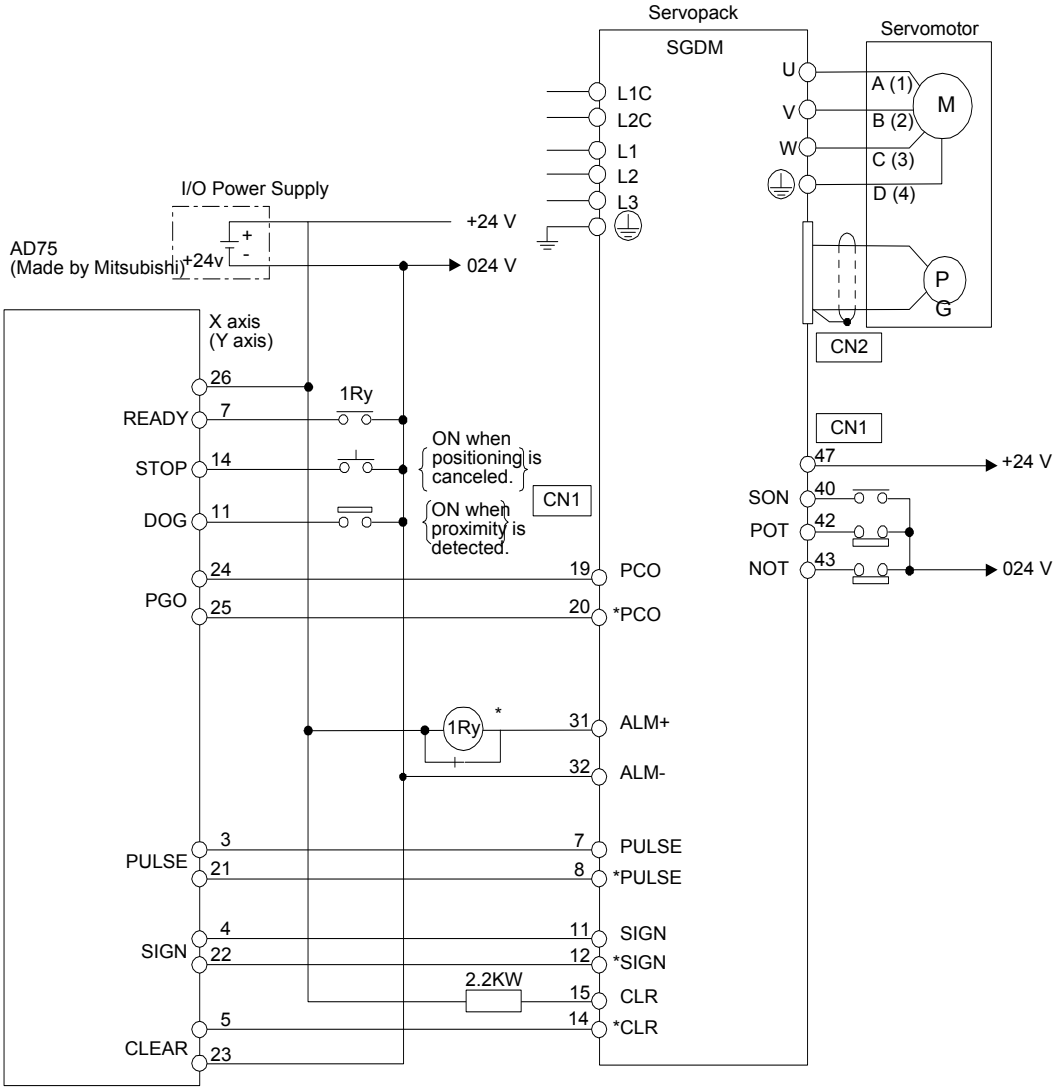
*3. Connect the connector wire of the cable to the connector shell.

*. P indicates twisted pair wires

Note Only signals applicable to MITSUBISHI's AD72 Positioning Unit and Yaskawa's SGDM servo amplifier are shown here.

A.7 Connecting MITSUBISHI's AD75 Positioning Unit

The following diagram shows an example of connecting to the MITSUBISHI AD75 Positioning Unit. In this example, the servo amplifier is used in Position Control Mode.



*1. The ALM signal is output for approximately two seconds when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the servopack.

Note Only signals applicable to MITSUBISHI's AD75 Positioning Unit and Yaskawa's SGDM servo amplifier are shown here.

B List of Parameters

This appendix lists the parameters, switches, input signal selections, out put signal selections, auxiliary functions, and monitor modes for SGDH servo amplifiers.

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B.1 Parameters

The following list shows parameters and their settings.

Cat.	Parameter Number	Name	Unit	Setting Range	Default Setting	Reference
Function Selection Parameters	**Pn000***	Function Selection Basic Switches	—	—	0000	5.1.1, 5.3.5
	Pn001*	Function Selection Application Switches 1**	—	—	0000	5.1.2, 5.4.2, 5.5.7
	Pn002*	Function Selection Application Switches	—	—	0000	5.2.8, 5.2.9, 5.7.2
	Pn003	Function Selection Application Switches 3	—	—	0002	6.5
Gain Parameters	Pn100	Speed Loop Gain	Hz	1 to 2000	40	6.2.1
	Pn101	Speed Loop Integral Time Constant	0.01ms	15 to 51200	2000	6.2.1
	Pn102	Position Loop Gain	s^{-1}	1 to 2000	40	6.2.1
	Pn103	Inertia Ratio	%	0 to 10000	0	6.2.1, 6.3.3 ■
	Pn104	2nd Speed Loop Gain	Hz	1 to 2000	40	—
	Pn105	2nd Speed Loop Integral Time Constant	0.01ms	15 to 51200	2000	—
	Pn106	2nd Position Loop Gain	s^{-1}	1 to 2000	40	—
	Pn107	Bias	rpm	0 to 450	0	6.2.4
	Pn108	Bias Width Addition	ref. units	0 to 250	7	6.2.4
	Pn109	Feed-Forward	%	0 to 100	0	6.2.2
	Pn10A	Feed-Forward Filter Time Constant	0.01ms	0 to 6400	0	—
	Pn10B*	Gain-Related Application Switches	—	—	0000	6.2.5*
	Pn10C	Mode Switch Torque Reference	%	0 to 800	200	6.2.5
	Pn10D	Mode Switch Speed Reference	rpm	0 to 10000	0	6.2.5
	Pn10E	Mode Switch Acceleration	10rpm/s	0 to 3000	0	6.2.5
	Pn10F	Mode Switch Error Pulse	ref. units	0 to 10000	0	6.2.5
	Pn110*	Online Autotuning Switches	—	—	0010	6.3.4
	Pn111	Speed Feedback Compensation***	%	1 to 500	100	6.2.6
	Pn112	Reserved parameters (Do not change.)	%	0 to 1000	100	—
	Pn113		—	0 to 10000	1000	—
	Pn114		—	0 to 400	200	—
	Pn115		—	0 to 1000	32	—
	Pn116		—	0 to 1000	16	—
	Pn117		%	20 to 100	100	—

Cat.	Parameter Number	Name	Unit	Setting Range	Default Setting	Reference
Gain Parameters	Pn118	Reserved parameters (Do not change).	%	20 to 100	100	—
	Pn119		s^{-1}	1 to 2000	50	—
	Pn11A		0.1%	1 to 2000	1000	—
	Pn11B		Hz	1 to 150	50	—
	Pn11C		Hz	1 to 150	70	—
	Pn11D		%	1 to 150	100	—
	Pn11E		%	1 to 150	100	—
	Pn11F		ms	1 to 2000	0	—
	Pn120		0.01ms	1 to 51200	0	—
	Pn121		Hz	10 to 250	50	—
	Pn122		Hz	0 to 250	0	—
	Pn123		%	0 to100	0	—
Position Parameters	**Pn200***	Position Control Reference Selection Switches	—	—	0000	5.2.2
	Pn201*	PG Divider	p/r	16 to 16384	16384	5.2.3
	Pn202*	Electronic Gear Ratio (Numerator)	—	1 to 65535	4	5.2.5
	Pn203*	Electronic Gear Ratio (Denominator) (See note 3).	—	1 to 65535	1	5.2.5
	Pn204	Position Reference Accel/Decel Parameter	0.01ms	0 to 6400	0	6.1.2
	Pn205*	Multi-Turn Limit Setting**	rev	0 to 65535	65535	5.7.2
	Pn206	Reserved parameter (Do not change).	P/rev	513 to 65535	16384	—
	Pn207*	Position Control Function Switches*	—	—	0000	5.2.9 6.1.2■
	Pn208*	Position Reference Movement Averaging Time	0.01ms	6 to 6400	0	6.1.2
Speed Parameters	Pn300	Speed Reference Input Gain	0.01V/ rated speed	150 to 3000	600	5.2.1
	Pn301	Speed 1	rpm	0 to 10000	100	5.2.6
	Pn302	Speed 2	rpm	0 to 10000	200	5.2.6
	Pn303	Speed 3	rpm	0 to 10000	300	5.2.6
	Pn304	Jog Speed	rpm	0 to 10000	500	5.3.2
	Pn305	Soft Start Acceleration Time	ms	0 to 10000	0	6.1.1
	Pn306	Soft Start Deceleration Time	ms	0 to 10000	0	6.1.1
	Pn307	Speed Reference Filter Time Constant	0.01ms	0 to 65535	40	—
	Pn308	Speed Feedback Filter Time Constant	0.01ms	0 to 65535	0	6.2.6
Torque Parameters	Pn400	Torque Reference Input Gain	0.1V/rated torque	10 to 100	30	5.2.7
	Pn401	Torque Reference Filter Time Constant	0.01ms	0 to 65535	100	6.1.5
	Pn402	Forward Torque Limit	%	0 to 800	800	5.1.3
	Pn403	Reverse Torque Limit	%	0 to 800	800	5.1.3
	Pn404	Forward External Torque Limit	%	0 to 800	100	5.1.3
	Pn405	Reverse External Torque Limit	%	0 to 800	100	5.1.3
	Pn406	Emergency Stop Torque	%	0 to 800	800	5.1.2
	Pn407	Speed Limit during Torque Control	rpm	0 to 10000	10000	5.2.7
	Pn408	Torque Function Switches	—	—	0000	6.1.6
	Pn409	Notch Filter Frequency	Hz	50 to 2000	2000	6.1.6

Cat.	Parameter Number	Name	Unit	Setting Range	Default Setting	Reference
Sequence Parameters	Pn500	Positioning Completed Width	ref. units	0 to 250	7	5.5.3
	Pn501	Zero Clamp Level	rpm	0 to 10000	10	5.4.3
	Pn502	Rotation Detection Level	rpm	1 to 10000	20	5.5.5
	Pn503	Speed Coincidence Signal Output Width	rpm	0 to 100	10	5.5.4
	Pn504	NEAR Signal Width	ref. units	1 to 250	7	5.5.8
	Pn505	Overflow Level	256 ref. units	1 to 32767	1024	6.2.1
	Pn506	Brake Reference Servo OFF Delay Time	10ms	0 to 50	0	5.4.4
	Pn507	Brake Reference Output Speed Level	rpm	0 to 10000	100	5.4.4
Sequence Parameters	Pn508	Timing for Brake Reference Output during Motor Operation	10ms	10 to 100	50	5.4.4
	Pn509	Momentary Hold Time	ms	20 to 1000	20	5.5.9
	Pn50A*	Input Signal Selections 1	—	—	2100	5.3.3
	Pn50B*	Input Signal Selections 2	—	—	6543	5.3.3
	Pn50C*	Input Signal Selections 3	—	—	8888	5.3.3
	Pn50D*	Input Signal Selections 4	—	—	8888	5.3.3
	Pn50E*	Output Signal Selections 1	—	—	3211	5.3.4
	Pn50F*	Output Signal Selections 2	—	—	0000	5.3.4
	Pn510*	Output Signal Selections 3	—	—	0000	5.3.4*
	Pn511	Reserved parameter (Do not change).	—	—	8888	—
	Pn512*	Output Signal Reversal Settings	—	—	0000	5.3.4
Other Parameters	Pn600	Regenerative Resistor Capacity ◆	10W	0 to capacity❖	0	5.6.1
	Pn601	Reserved parameter (Do not change.)	—	—	0	—

* **After changing these parameters, cycle the main circuit and control power supplies to enable the new settings.**

** The multi-turn limit is valid only when parameter Pn002.2 Absolute Encoder Usage is set to "2". The value will be processed in the range of "+32767 to -32768" for other settings even if the value is changed. There is no need to change the multi-turn limit except for in special cases. Be careful not to change the setting unless necessary.

*** The setting of parameter Pn111 is valid only when parameter Pn110.1 is set to 0.

■ For SGDH at version #33□□□ or higher. See Sec. B7.

◆ Normally set to "0". When using an external regenerative resistor, set to the derated capacity (W) of the regenerative resistor.

❖ The upper limit is the maximum output capacity (W) of the servo amplifier.

B.1.1 List of Additional and Improved Parameters (Applicable only to SGDH amplifiers with version #33□□□ or higher)

This chapter describes the parameters added or improved in the upgraded version products.

■ Parameters

The specifications shown in shaded column are the modified items.

Cat.	Parameter No.	Name	Unit	Lower Limit	Upper Limit	Factory Setting	Remarks
Function Selection Parameters	Pn004	Function Selection Application Switches 4 *1	–	0000H	1110H	0000H	The settings on 2nd and 3rd digits are added.
	Pn080	Function Selection Basic Switches (Only for linear motors) *1	–	0000H	1011H	0000H	The setting on 3rd digit is added.
Gain Related Parameters	Pn103	Moment of Inertia Ratio	%	0	20000	0	Upper limit is modified.
	Pn10B	Gain-related Application Switches *1	–	0000H	2314H	0000H	The setting on 2nd digit is added.
	Pn110	Online Autotuning Switches	–	0010H	3212H	0000H	Modification only for large-capacity Servo Amplifiers* 2
	Pn124	Automatic Gain Switching Timer	ms	1	10000	100	Newly added
	Pn125	Automatic Gain Switching Width	Reference Unit	1	250	7	Newly added

Cat.	Parameter No.	Name	Unit	Lower Limit	Upper Limit	Factory Setting	Remarks
Position Related Parameters	Pn207	Position Control Function Switches *1	–	0000H	1111H	0000H	The setting on 2nd digit is added.
	Pn212	PG Dividing Ratio *1 and 3	pulse	0000000016	1073741824	2048	Newly added
	Pn217	Reference Pulse Input Multiplication	× 1	1	99	1	Newly added
	Pn218	Reference Pulse Multiplication Function Selection *1	–	0000H	0001H	0000H	Newly added
	Pn281	PG Dividing Ratio (Only for linear motors) *1	pulse/ scale pitch	1	255	20	Upper limit is modified from 256 to 255.
Speed Related Parameters	Pn309	Reserved (Do not change.)	rpm	0	500	60	Newly added
	Pn384	Motor Max. Speed (Only for linear motors)	100mm/s	1	100	50	Newly added
Torque Related Parameters	Pn408	Torque-related Function Switches	Å|	0000H	0101H	0000H	The setting on 2nd digit is added.
	Pn40A	Notch Filter Q Value	× 0.01	50	400	70	Newly added
	Pn40B	Second Stage Notch Filter Frequency	Hz	50	2000	2000	Newly added
	Pn40C	Second Stage Notch Filter Q Value	× 0.01	50	400	70	Newly added

Cat.	Parameter No.	Name	Unit	Lower Limit	Upper Limit	Factory Setting	Remarks
Sequence Related Parameters	Pn510	Output Signal Selections 3 *1	–	0000H	0333H	0000H	The setting on 2nd digit is added.
	Pn513	Input Signal Selections 5 *1	–	0000H	00FFH	0088H	Newly added
	Pn51A	Position Error Level Between Motor and Load	Reference Unit	0	32767	0	Lower limit is modified from 1 to 0. Factory Setting is modified from 10 to 0.
	Pn51B	Reserved (Do not change.)	256 Reference Unit	1	32767	100	Newly added
	Pn51C	Reserved (Do not change.)	rpm	0	10000	450	Newly added
	Pn51E	Excessive Position Error Warning Level	%	0	100	0	Newly added
	Pn584	Linear Motor Self-Cooling Ratio	%/Maxi-mum Speed	0	100	0	Newly added

*1: After changing these parameters, turn OFF the control power supply and then turn it ON again to enable the new settings.

*2: The factory setting of Pn110.0 for large-capacity (more than 15 kW) servo amplifiers is different from the others:
15 kW or less: Pn110.0 = 0 (Tunes only at the beginning of operation)
More than 15 kW: Pn110.0 = 2 (Autotuning not performed)

*3: The upper limit differs depending on the resolution (number of bits) of the encoder connected to the servo amplifier.
Upper Limit: (2 numbers of encoder bits) / 4
When no encoder is connected, the value in the above list is the upper limit.
For further information on the restrictions, refer to *4.2 Additional Setup Procedures in Trial Operation*.

B.2 Switches

The following list shows the switches and their default settings.

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn000 Function Selection Basic Switches	0	Direction Selection	0	Sets CCW as forward direction.	0
			1	Sets CW as forward direction (reverse rotation mode).	
	1	Control Method Selection	0	Speed control (analog reference).	0
			1	Position control (pulse train reference).	
			2	Torque control (analog reference).	
			3	Internal set speed control (contact reference).	
			4	Internal set speed control (contact reference)/Speed control (analog reference).	
			5	Internal set speed control (contact reference)/Position control (pulse train reference).	
			6	Internal set speed control (contact reference)/Torque control (analog reference).	
			7	Position control (pulse train reference)/Speed control (analog reference).	
			8	Position control (pulse train reference)/Torque control (analog reference).	
			9	Torque control (analog reference)/Speed control (analog reference).	
			A	Speed control (analog reference)/Zero clamp.	
			B	Position control (pulse tra.in reference)/Position control (Inhibit)	
	2	Axis Address	0 to F	Sets servo amplifier axis address.	0
	3	Reserved		—	0
Pn001 Function Selection Application Switches	0	Servo OFF or Alarm Stop Mode	0	Stops the motor by applying dynamic brake (DB).	0
			1	Stops the motor by applying dynamic brake (DB) and then releases DB.	
			2	Makes the motor coast to a stop state without using the dynamic brake (DB).	
	1	Overtravel Stop Mode	0	Same setting as Pn001.0 (Stops the motor by applying DB or by coasting.)	0
			1	Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to servo lock state.	
			2	Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to coasting state.	
	2	AC/DC Power Input Selection	0	Not applicable to DC power input: Input AC power supply through L1, L2, and (L3) terminals.	0
			1	Applicable to DC power input: Input DC power supply through (+)1 and (-) terminals.	
	3	Warning Code Output Selec-tion	0	ALO1, ALO2, and ALO3 output only alarm codes.	0
			1	ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).	

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn002 Function Selection Application Switches	0	Speed Control Option (T-REF Terminal Allocation)	0	None.	0
			1	Uses T-REF as an external torque limit input.	
			2	Uses T-REF as a torque feed-forward input.	
			3	Uses T-REF as an external torque limit input when P-CL and N-CL are ON.	
	1	Torque Control Option (V-REF Terminal Allocation)	0	None.	0
			1	Uses V-REF as an external speed limit input.	
	2	Absolute Encoder Usage	0	Uses absolute encoder as an absolute encoder.	0
			1	Uses absolute encoder as an incremental encoder.	
	3	Not used.	0	DO NOT CHANGE (Turns OFF PG output for full-closed option card, FC100)PG output is OFF if set to 1.	0
Pn003 Function Selection Application Switches	0	Analog Monitor 1 Torque Reference Monitor	0	Motor speed: 1V/1000rpm.	2
			1	Speed reference: 1V/1000rpm.	0
			2	Torque reference: 1V/100%.	
			3	Position error: 0.05V/1 reference units.	
			4	Position error: 0.05V/100 reference units.	
			5	Reference pulse frequency (converted to rpm): 1V/1000rpm.	
			6	Motor speed × 4: 1V/250rpm.	
			7	Motor speed × 8: 1V/125rpm.	
	1	Analog Monitor 2 Speed Reference Monitor	8	Reserved parameter (Do not change.).	
			9		
			A		
			B		
			C		
			D		
			E		
			F		
	2	Not used.	—	—	0
	3	Not used.	—	—	0
Pn10B Gain Application Switches	0	Mode Switch Selection	0	Uses internal torque reference as the condition (Level setting: Pn10C).	0
			1	Uses speed reference as the condition (Level setting: Pn10D).	
			2	Uses acceleration as the condition (Level setting: Pn10E).	
			3	Uses error pulse as the condition (Level setting: Pn10F).	
			4	No mode switch function available.	
	1	Speed Loop Control Method	0	PI control.	0
			1	IP control.	
	2	Not used.	0	—	0
	3	Reserved	0 to 2	Reserved parameter. (Do not change).	0

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn110 Online Autotuning Switches	0	Online Auto-tuning Method	0	Tunes only at the beginning of operation.	0
			1	Always tunes.	
			2	Does not perform autotuning.	
	1	Speed Feed-back Compen-sation Selection	0	Enabled.	1
			1	Disabled.	
	2	Friction Com-pensation Selection	0	Friction compensation: Disabled.	0
			1	Friction compensation: Small.	
			2	Friction compensation: Large.	
	3	Reserved	0 - 3	Reserved parameter (Do not change).	0
Pn200 Position Control References Selection Switches	0	Reference Pulse Form	0	Sign + pulse, positive logic.	0
			1	CW + CCW, positive logic.	
			2	A phase + B phase (x1), positive logic.	
			3	A phase + B phase (x2), positive logic.	
			4	A phase + B phase (x4), positive logic.	
			5	Sign + pulse, negative logic.	
			6	CW + CCW, negative logic.	
			7	A phase + B phase (x1), negative logic.	
			8	A phase + B phase (x2), negative logic.	
			9	A phase + B phase (x4), negative logic.	
	1	Error Counter Clear Signal Form	0	Clears error counter when the signal goes high.	0
			1	Clears error counter at the rising edge of the signal.	
			2	Clears error counter when the signal goes low.	
			3	Clears error counter at the falling edge of the signal.	
	2	Clear Operation	0	Clears error counter at the baseblock.	0
			1	Does not clear error counter. (Possible to clear error counter only with CLR signal).	
			2	Clears error counter when an alarm occurs.	
	3	Filter Selection	0	Reference input filter for line driver signals.	0
			1	Reference input filter for open collector signals.	
Pn207 Position Control Function Switches	0	Position Reference Filter Selection	0	Acceleration/deceleration filter.	0
			1	Average movement filter.	
	1	Position Control Option	0	Disabled.	
			1	Uses V-REF as a speed feed-forward input.	
	2			—	
	3			—	

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn408 Torque Control Function Switches	0	Notch Filter Selection	0	Disabled.	0
			1	Uses a notch filter for torque reference.	
	1	Not used.	—	—	
	2				
	3				

B.2.1 Additional Switches (Applicable only to SGDH amplifiers with version #33□□□ or higher)

Parameter No.	Digit Place	Name	Setting	Description	Factory Setting	Remarks
Pn004 Function Selection Application Switches	2	Fixed parameter (Do not change.)	0	?	0	
	3	Fixed parameter (Do not change.)	0	?	0	
Pn080 Function Selection Basic Switches (Only for linear motors)	3	Allowable maximum motor speed/ dividing ratio calculation selection (The result of calculation is displayed in Un010.)	0	Fix the maximum motor speed, and calculate the allowable maximum dividing ratio.	0	The setting on 3rd digit is added.
			1	Fix the maximum dividing ratio, and calculate the allowable maximum motor speed.		
Pn10B Gain Application Switches	2	Automatic gain switching selection	0	Automatic gain switching disabled	0	The setting 2nd digit is added.
			1	Position reference		
			2	Position error		
			3	Position reference and position error		
Pn207 Position Control Function Switches	2	Dividing ratio parameter selection	0	Use Pn201 (16-bit or less)	0	The setting on 2nd digit is added.
			1	Use Pn212 (17-bit or more)		
Pn218	0	Reference pulse multiplication function selection	0	Disabled	0	Newly added
			1	Enabled		
Pn408 Torque Function Switches	2	Second stage notch filter selection	0	Disabled	0	The setting on 2nd digit is added.
			1	Enabled		

B.3 Input Signal Selections

The following list shows input signal selections and their default settings.

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn50A	0	Input Signal Allocation Mode	0	Sets the input signal allocation for the sequence to the same one as for the SGDB servo amplifier[1].	0
			1	Possible to freely allocate the input signals.	
	1	/S-ON Signal Mapping (Servo ON when low.)	0	Inputs from the SI0 (CN1-40) input terminal.	0: SI0
			1	Inputs from the SI1 (CN1-41) input terminal.	
			2	Inputs from the SI2 (CN1-42) input terminal.	
			3	Inputs from the SI3 (CN1-43) input terminal.	
			4	Inputs from the SI4 (CN1-44) input terminal.	
			5	Inputs from the SI5 (CN1-45) input terminal.	
			6	Inputs from the SI6 (CN1-46) input terminal.	
			7	Sets signal ON.	
			8	Sets signal OFF.	
			9	Inputs the reverse signal from the SI0 (CN1-40) input terminal.	
			A	Inputs the reverse signal from the SI1 (CN1-41) input terminal.	
			B	Inputs the reverse signal from the SI2 (CN1-42) input terminal.	
			C	Inputs the reverse signal from the SI3 (CN1-43) input terminal.	
			D	Input the reverse signals from the SI4 (CN1-44) input terminal.	
			E	Inputs the reverse signal from the SI5 (CN1-45) input terminal.	
			F	Inputs the reverse signal from the SI6 (CN1-46) input terminal.	
	2	/P-CON Signal Mapping (Pcontrol when low.)	0 to F	Same as above.	1: SI1
	3	P-OT Signal Mapping (Ove-travel when high.)	0 to F	Same as above.	2: SI2
Pn50B	0	N-OT Signal Mapping (Overtravel when high.)	0 to F	Same as above.	3: SI3
	1	/ALM-RST Signal Mapping (Alarm reset when low.)	0 to F	Same as above.	4: SI4
	2	/P-CL Signal Mapping (Torque control when low.)	0 to F	Same as above.	5: SI5
	3	/N-CL Signal Mapping (Torque control when low.)	0 to 8	Same as above.	6: SI6

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn50C	0	/SPD-D Signal Mapping (Internal Set Speed Selection)	0 to F	Same as above.	8: OFF
	1	/SPD-A Signal Mapping (Internal Set Speed Selection)	0 to F	Same as above.	8: OFF
	2	/SPD-B Signal Mapping (Internal Set Speed Selection)	0 to F	Same as above.	8: OFF
	3	/C-SEL Signal Mapping (Control Mode Switching)	0 to F	Same as above.	8: OFF
Pn50D	0	/ZCLAMP Signal Mapping (Zero Clamping)	0 to F	Same as above.	8: OFF
	1	/INHIBIT Signal Mapping (Disabling Reference Pulse)	0 to F	Same as above.	8: OFF
	2	/G-SEL Signal Mapping (Gain Switching)	0 to F	Same as above.	8: OFF
	3	(Reserved)	0 to F	Same as above.	8: OFF
Pn513	0	/PSEL Signal Mapping (Reference pulse input multiplication)	0	Inputs from the SI0 (CN1-40) input terminal.	8: Set signal OFF
			1	Inputs from the SI1 (CN1-40) input terminal.	
			2	Inputs from the SI2 (CN1-40) input terminal.	
			3	Inputs from the SI3 (CN1-40) input terminal.	
			4	Inputs from the SI4 (CN1-40) input terminal.	
			5	Inputs from the SI5 (CN1-40) input terminal.	
			6	Inputs from the SI6 (CN1-40) input terminal.	
			7	Sets signal ON.	
			8	Sets signal OFF.	
			9	Inputs the reverse signal from SI0 (CN1-40) input terminal.	
			A	Inputs the reverse signal from the SI1 (CN1-40) input terminal.	
			B	Inputs the reverse signal from the SI2 (CN1-40) input terminal.	
			C	Inputs the reverse signal from the SI3 (CN1-40) input terminal.	
			D	Inputs the reverse signal from SI4 (CN1-40) input terminal.	
			E	Inputs the reverse signal from SI5 (CN1-40) input terminal.	
			F	Inputs the reverse signal from SI6 (CN1-40) input terminal.	

*1 When Pn50A.0 is set to 0 for the SGDH servo amplifier, only the following modes are compatible: Pn50A.1=7, Pn50A.3=8, and Pn50B.0=8.

B.4 Output Signal Selections

The following list shows output signal selections and their default settings.

Parameter	Digit Place	Name	Setting	Description	Default Setting
Pn50E	0	/COIN Signal Mapping	0	Disabled.	1: SO1
			1	Outputs from the SO1 (CN1-25, 26) output terminal.	
			2	Outputs from the SO2 (CN1-27, 28) output terminal.	
			3	Outputs from the SO3 (CN1-29, 30) output terminal.	
	1	/V-CMP Signal Mapping	0 to 3	Same as above	1: SO1
	2	/TGON Signal Mapping	0 to 3	Same as above	2: SO2
	3	/S-RDY Signal Mapping	0 to 3	Same as above	3: SO3
Pn50F	0	/CLT Signal Mapping	0 to 3	Same as above	0: Not used
	1	/VLT Signal Mapping	0 to 3	Same as above	
	2	/BK Signal Map ping	0 to 3	Same as above	
	3	/WARN Signal Mapping	0 to 3	Same as above	
Pn510	0	/NEAR Signal Mapping	0 to 3	Same as above	
	1	Reserved	0 to 3	Same as above	
	2	Not used.	0	—	0
	3	Not used.	0	—	0
Pn512	0	Output Signal Reversal for SO1 (CN-25 and 26)	0	Output signal is not reversed.	0: Not reversed
			1	Output signal is reversed.	
	1	Output Signal Reversal for SO2 (CN-25 and 26)	0	Output signal is not reversed.	
			1	Output signal is reversed.	
	2	Output Signal Reversal for SO3 (CN-25 and 26)	0	Output signal is not reversed.	
			1	Output signal is reversed.	
	3	Not used.	—	—	0

Notes: 1. When more than one signal is allocated to the same output circuit, data is output using OR logic.

2. Depending on the control mode, undetected signals are treated as OFF. For example, in the speed control mode, the /COIN signal is treated as OFF.

3. Types of /WARN signals: Overload and regenerative overload.

B.4.1 Additional Output Signal Selection (Applicable only to SGDH amplfiers with version # 33□□□ or higher)

Parameter No.	Digit Place	Name	Setting	Contents	Factory Setting	Remarks
Pn510	2	/PSELA Signal Mapping	0	Disabled	0: Disabled	The setting on 2nd digit is added.
			1	Outputs from the SO1 (CN1-25, 26) output terminal.		
			2	Outputs from the SO2 (CN1-27, 28) output terminal.		
			3	Outputs from the SO3 (CN1-29, 30)) output terminal.		

B.5 Auxiliary Functions

The following list shows the available auxiliary functions.

Parameter	Function
Fn000	Alarm traceback data display.
Fn001	Rigidity setting for online autotuning.
Fn002	JOG mode operation.
Fn003	Zero-point search mode.
Fn004	(Reserved parameter).
Fn005	Parameter settings initialization.
Fn006	Alarm traceback data clear.
Fn007	Writing to EEPROM inertia ratio data obtained from online autotuning.
Fn008	Absolute encoder multi-turn reset and encoder alarm reset.
Fn009	Automatic tuning of analog (speed, torque) reference offset.
Fn00A	Manual adjustment of speed reference offset.
Fn00B	Manual adjustment of torque reference offset.
Fn00C	Manual zero-adjustment of analog monitor output.
Fn00D	Manual adjustment of analog monitor output gain.
Fn00E	Automatic adjustment of motor current detection signal offset.
Fn00F	Manual adjustment of motor current detection signal offset.
Fn010	Write protect setting (protects parameters from being changed).
Fn011	Motor model display. (See Below)
Fn012	Software version display.
Fn013	Multi-Turn Limit Setting: Change when a Multi-Turn Limit Disagreement Alarm (A.CC) occurs.
Fn014	Clear Option Unit Detection Alarm (A.E7).

B.5.1 Detail of Fn011 (Motor Model Display)

Parameter No.	Contents of Display		Remarks
Fn011	Servomotor model is added. F.□□■■	□□: No modification in voltage designation ■■ : Servomotor models 32: SGMCS-□□C 33: SGMCS-□□D 34: SGMCS-□□B 35: SGMCS-□□E 36: SGMCS-□□L 37: SGMCS-□□M 38: SGMCS-□□N 39: SGMCS-□□R	Only the additional models are described.(Applicable only to SGDH amplifiers with version # 33□□□ or higher) Refer to Section 1.1.2 for details.
	Encoder model is added. E. □□■■	□□ : Encoder models 00: Incremental 01: Multiturn data absolute 02: Single-turn data absolute ■■: No modification in encoder resolution designation	

B.6 Monitor Modes

The following list shows monitor modes available

Parameter	Content of Display	Unit	Remarks
Un000	Actual motor speed	rpm	—
Un001	Input speed reference	rpm	—
Un002	Internal torque reference	%	Value for rated torque
Un003	Rotation angle 1	pulse	Number of pulses from the origin
Un004	Rotation angle 2	degree	Angle from the origin (electrical angle)
Un005	Input signal monitor	—	—
Un006	Output signal monitor	—	—
Un007	Input reference pulse speed	rpm	—
Un008	Error counter value	reference units	Amount of position error
Un009	Accumulated load rate	%	Value for the rated torque Displays in 10s cycle.
Un010	Allowable maximum motor speed/ dividing ratio	100 mm/s or Pulse/scale pitch (Pn280)	Displays in decimal codes.
Un011	Hall sensor signals	–	–
Un00A	Regenerative load rate	%	Value for the processable regenerative power Displays in 10s cycle.
Un00B	Power consumed by DB resistance	%	Value for the processable power when dynamic brake is applied Displays in 10s cycle.
Un00C	Input reference pulse counter	—	Displayed in hexadecimal.
Un00D	Feedback pulse counter	—	Displayed in hexadecimal.
Un100~ UN104	Reserved	—	—

B.7 List of Added & Changed Parameters

This chapter explains about the parameters, monitors, functions, and alarms added and/or changed for SGDH in versions 33□□□ or higher.

B.7.1 Parameter list

Note: The changed part in the parameter changed is highlighted in gray

Category	Parameter	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Function selection parameters	**Pn080**	Function selection base switch (Linear motor only)*1*	–	0000H	1011H	0000H
Gain related parameters	Pn103	Inertia ratio	%	0	20000	0
	Pn10B	Gain related application switch*1*	–	0000H	2314H	0000H
Position related parameters	**Pn207**	Position control function switch*1*	–	0000H	1111H	0000H
	Pn212	Dividing ratio*1*	pulse	00002048	00262144	2048
	Pn217	Reference pulse input magnification	×1	1	99	1
	Pn218	Reference pulse magnification function selection *1*	–	0000H	0001H	0000H
	Pn281	PG dividing ratio (Linear motor only*1*	pulse/ Scale pitch	1	255	20
Speed related parameters	Pn384	Motor peak speed (Linear motor only)	100mm/s	1	100	50
Torque related parameters	Pn408	Torque related function switch	–	0000H	0101H	0000H
	Pn40A	Notch filter Q value	×0.01	50	400	70
	Pn40B	Notch filter two frequencies	Hz	50	2000	2000
	Pn40C	Notch filter two Q value	×0.01	50	400	70

Category	Parameter	Name	Unit	Lower Limit	Upper Limit	Factory Setting
Sequence related parameters	**Pn510**	Output signal setting 3*1	–	0000H	0333H	0000H
	Pn513	Input signal selection 5*1	–	0000H	00FFH	0088H
	Pn51E	Excessive position error warning level	%	0	100	0
	Pn584	Self-propelled cooling rate of motor (Linear motor only)	%/ Peak speed	0	100	0

*1 Cycle the control power to make the function effective after changing the parameters.

B.7.2 Switch list

Parameter	Digit Place	Name	Setting	Description	Factory Setting
Pn080 Function selection base (Linear exclusive use)	3	Settable peak speed of motor /Dividing ratio calculation selection (The calculated value is displayed in Un010)	0	Peak speed of the motor is fixed, and a settable dividing ratio is calculated.	0
			1	The dividing ratio is fixed, and settable peak speed of the motor is calculated.	
Pn10B Gain related application	2	Automatic gain switch selection	0	No automatic gain switch	0
			1	Only the positioning reference	
			2	Only the position error	
			3	Positioning reference and position error	
Pn207 Position control function	2	Dividing ratio parameter selection	0	Pn201 is used. (16 bits or less)	0
			1	Pn212 and Pn213 are used (17 bits or more)	
Pn218	0	Command pulse magnification function selection	0	Function disabled	0
				Function enabled	
Pn408 Torque related function	2	Notch filter two selections	0	N/A	0
			1	Available	

B.7.3 Input Signal Selection List

Input signal selection

Parameter	Digit Place	Name	Setting	Description	Factory Setting
Pn513	0	/PSEL Signal Mapping (Reference pulse input magnification)	0	Inputs from the SI0 (CN1-40) input terminal.	8: Disabled
			1	Inputs from the SI1 (CN1-40) input terminal.	
			2	Inputs from the SI2 (CN1-40) input terminal.	
			3	Inputs from the SI3 (CN1-40) input terminal.	
			4	Inputs from the SI4 (CN1-40) input terminal.	
			5	Inputs from the SI5 (CN1-40) input terminal.	
			6	Inputs from the SI6 (CN1-40) input terminal.	
			7	Fixes the signal to "Enabled".	
			8	Fixes the signal to "Disabled".	
			9	Inputs the inversion signal from the SI0 (CN1-40) input terminal.	
			A	Inputs the inversion signal from the SI1 (CN1-40) input terminal.	
			B	Inputs the inversion signal from the SI2 (CN1-40) input terminal.	
			C	Inputs the inversion signal from the SI3 (CN1-40) input terminal.	
			D	Inputs the inversion signal from the SI4 (CN1-40) input terminal.	
			E	Inputs the inversion signal from the SI5 (CN1-40) input terminal.	
			F	Inputs the inversion signal from the SI6 (CN1-40) input terminal.	

B.7.4 Output Signal Selection List

Output Signal Selection

Parameter	Digit Place	Name	Setting	Description	Factory Setting
Pn510	2	/PSELA Signal Mapping	0	Reserved	0: Reserved
			1	Outputs from the SO1 (CN1-25, 26) output terminal	
			2	Outputs from the SO2 (CN1-27, 28) output terminal	
			3	Outputs from the SO3 (CN1-29, 30) output terminal	

B.7.5 Monitor List

Parameter	Display	Unit
Un010	Peak speed of settable motor and dividing ratio monitor	100mm/s・Pulse/Scale Pitch (Pn280)
Un011	Hall sensor Signal Monitor	—

B.7.6 Auxiliary Function List

Parameter	Display	
Fn011	Encoder type added E. □□ ■■	□□: Encoder type 00: Incremental Encoder 01: Multi-rotation type absolute encoder 02: Rotation type absolute encoder ■■: There is no change about the encoder resolution.

Fn008 and Fn013 are not applicable for the one revolution absolute encoder. (Refer to the chapter3-16 for details)

B.7.7 Alarm and Warning List

Alarm list

Alarm	Alarm Code Output			Servo Alarm Output	Alarm Name	Alarm Occurrence Cause	Alarm Reset*1	Solution
	ALO1	ALO2	ALO3					
A.09	×	×	×	×	Dividing frequency setting error	The value of dividing frequency (Pn212) is set to an invalid value. Or the resolution of connected encoder is exceeded.	Cycle power	Change the setting of Pn212 (Pn213) to a settable value, and then cycle control power or reset the software.
						For linear motors, the deviding ratio exceeded the setting in Pn281.	Cycle power	Change the setting range to inside of the calculation result of Un010, and then cycle control power or reset the software.
A.0A	×	×	×	×	Encoder type unmatched	The attached serial encoder type is not supported. An alarm occurs when the encoder type is other than the followings. UTS*: Σ-II type serial encoder JZD*: Σ-II type serial encoder (Linear)	Cycle power	Change the motor to the Σ-II support type.
A.55	⌗	×	⌗	×	Setting error of linear motor peak speed	When the linear motor was connected, the value more than linear motor peak speed was set to Pn384.	resettable	Set Pn384 to below the linear motor peak speed.
A. b1	×	×	×	×	Reference A/D error	Reference A/D breakdown The A/D conversion result of 0V and ±5V generated inside the servo amplifier shifted by 1V or more, and this state continued for 20ms. Check only 0V when the servo is ON, and check 0V, and ±5V when the servo is OFF.	resettable	Replace the servo amplifier

Alarm list

Alarm	Alarm Code Output			Servo Alarm Output	Alarm Name	Alarm Occurrence Cause	Alarm Reset*1	Solution
	ALO1	ALO2	ALO3					
A. b3	×	×	×	×	Current detection error	For 1kW or smaller models. Amplifier stays in BB for 500ms after servo ON signal input and brake release with the servo in a ready state.	resettable	Check the wiring in motor power line. Replace the servo amplifier.
A.F5	×	⌗	×	×	Motor disconnection alarm	The detected torque is 10% or less, but the commanded torque reference is 90% or more for 10ms. This alarm is not activated in cases of BB due to hardware issues. In those cases, an A.F6 or A.b3 is generated instead.	resettable	Check the wiring in motor power line. Replace the servo amplifier.

Warning List

Warning	Warning Code Output			Warning Name	Warning Occurring Cause	Solution
	ALO1	ALO2	ALO3			
A.90	×	×	×	Excessive Position Error Warning	Position error exceeds Pn51E.	If a position error is within Pn51E, it automatically reset.

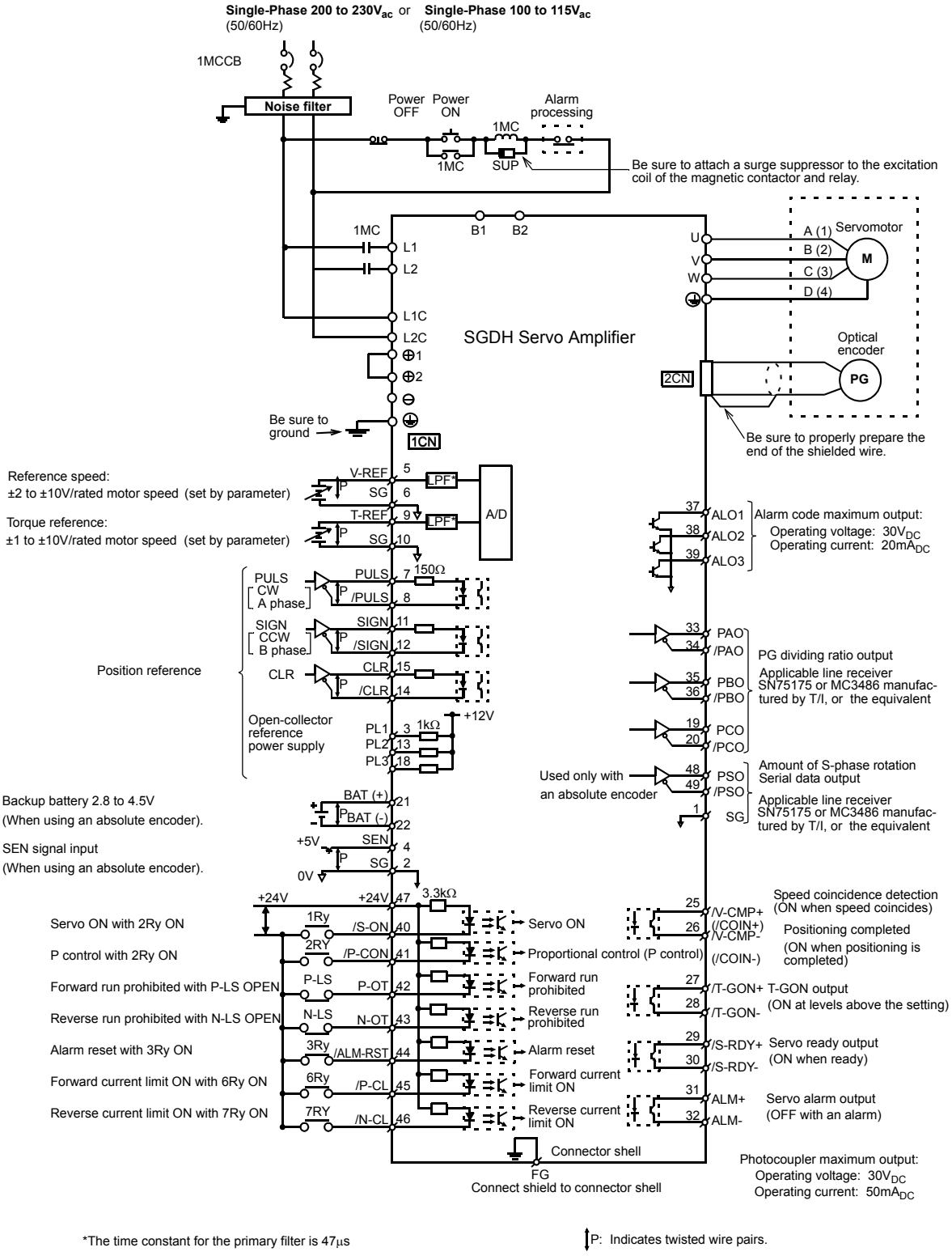
*1 Whether it is resettable after the cause of the alarm condition is removed, or whether power cycling is necessary in order to reset the device.

C Examples of Standard Connections

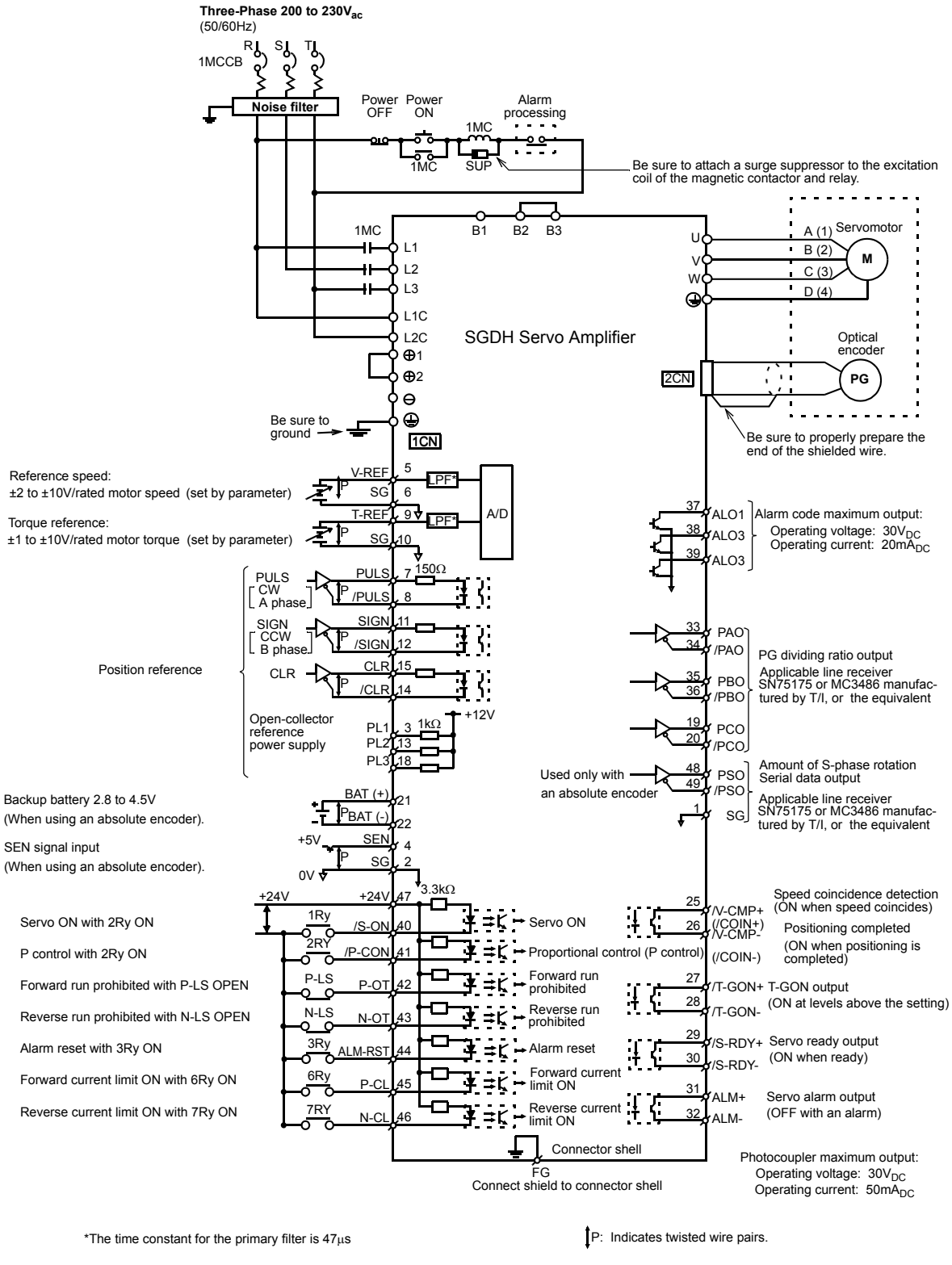
The following diagrams show examples of standard servo amplifier connections by specifications and type of control.

C.1 Single-Phase Power Supply Specifications C-2
C.2 Three-Phase Power Supply Specifications (200V).....C-3
C.3 Three-Phase Power Supply Specifications (400V).....C-4
Large Capacity Power Supply Specifications (400V) C-5
C.4 Position Control Mode.....C-7
C.5 Speed Control Mode C-8
C.6 Torque Control Mode.....C-9

C.1 Single-Phase Power Supply Specifications



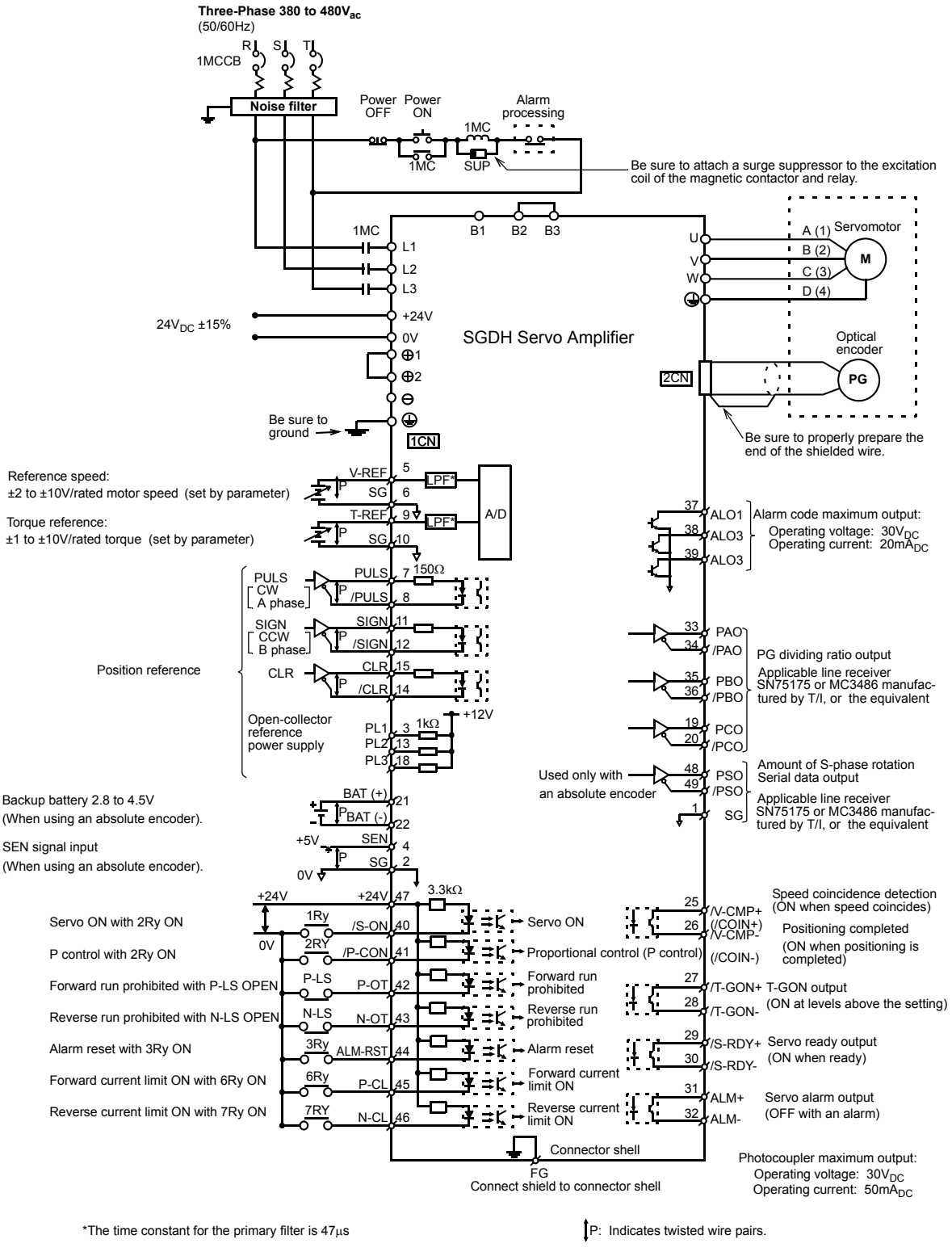
C.2 Three-Phase Power Supply Specifications (200V)



*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

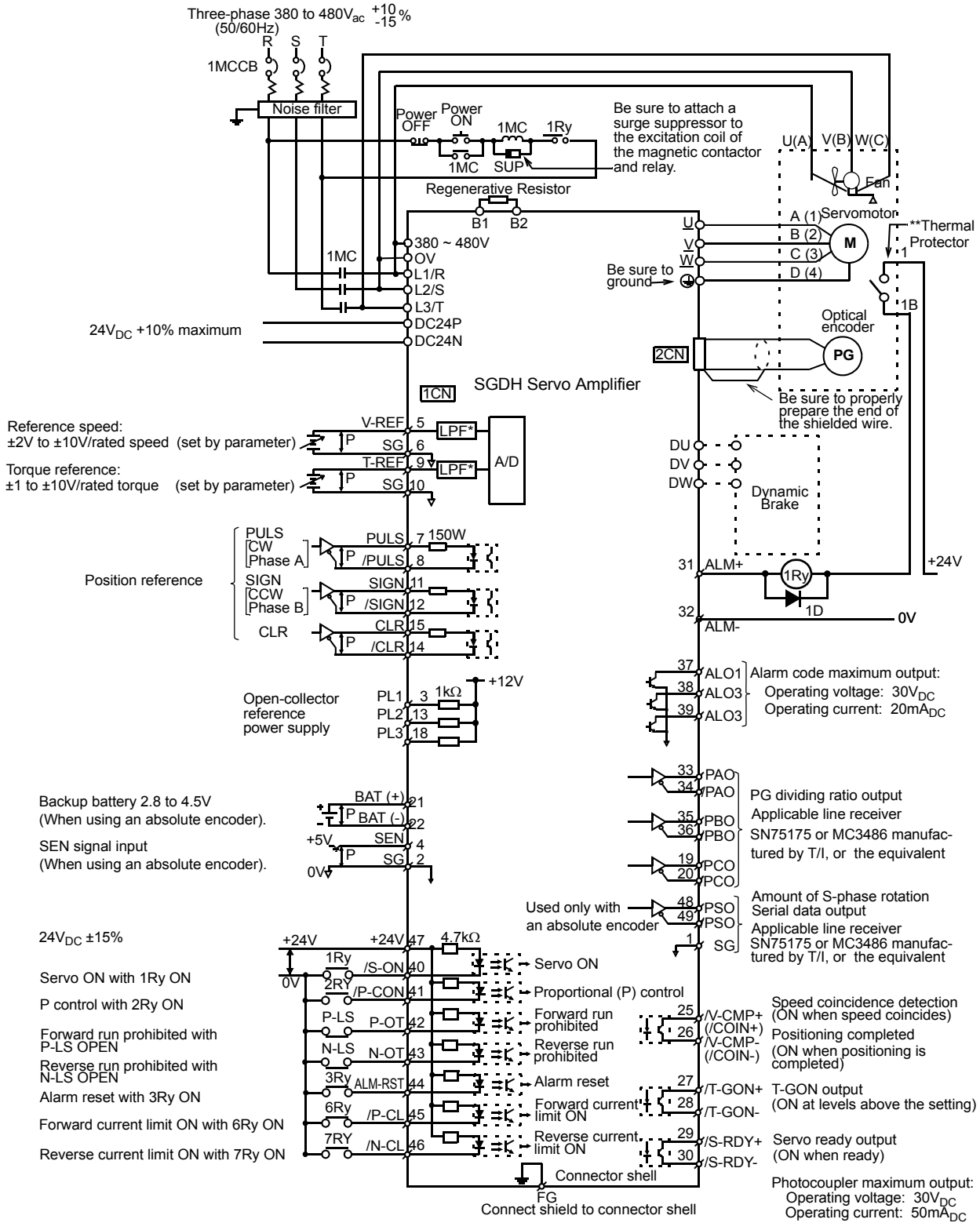
C.3 Three-Phase Power Supply Specifications (400V)



*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

400V (22kW, 30kW)

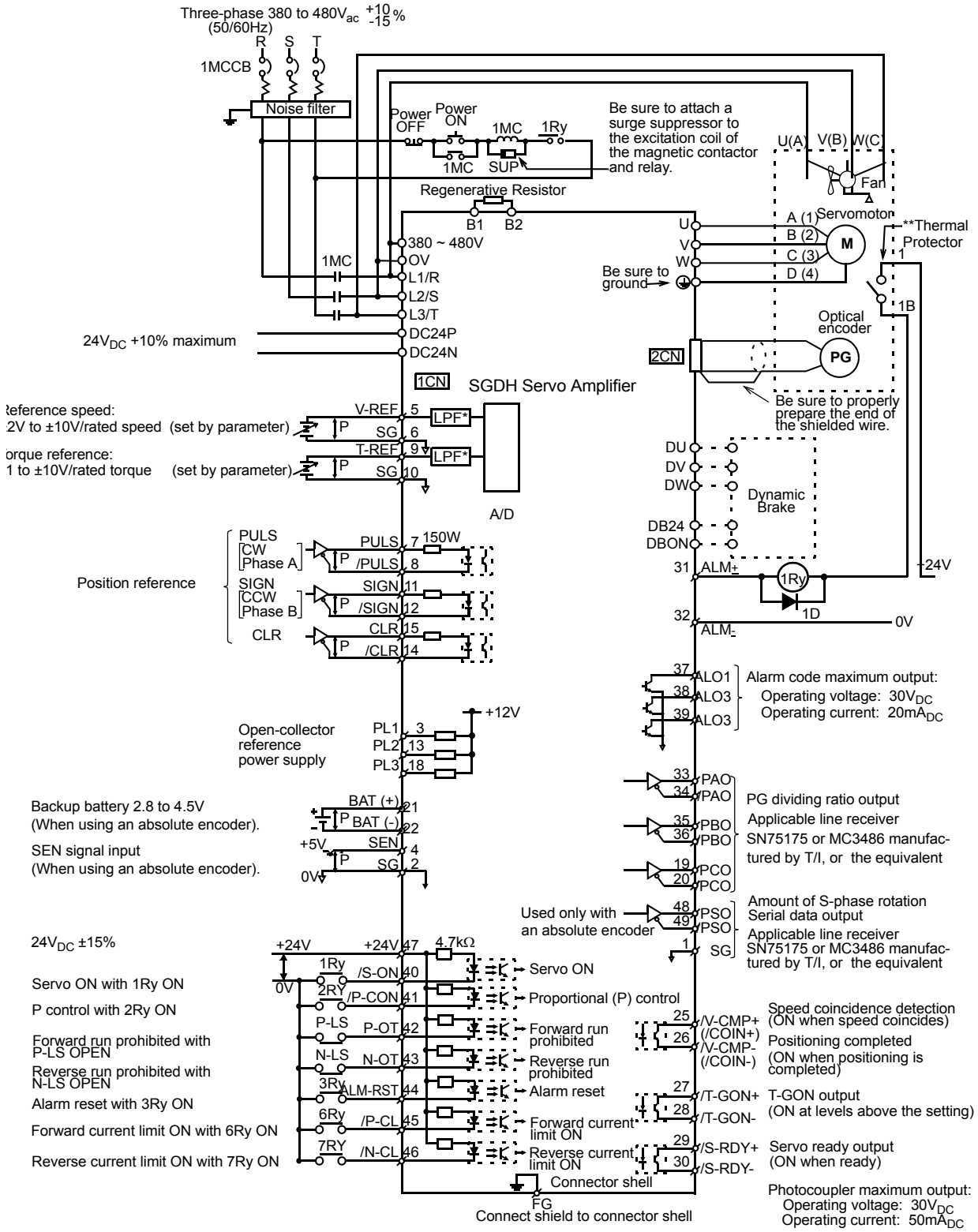


*The time constant for the primary filter is 47μs

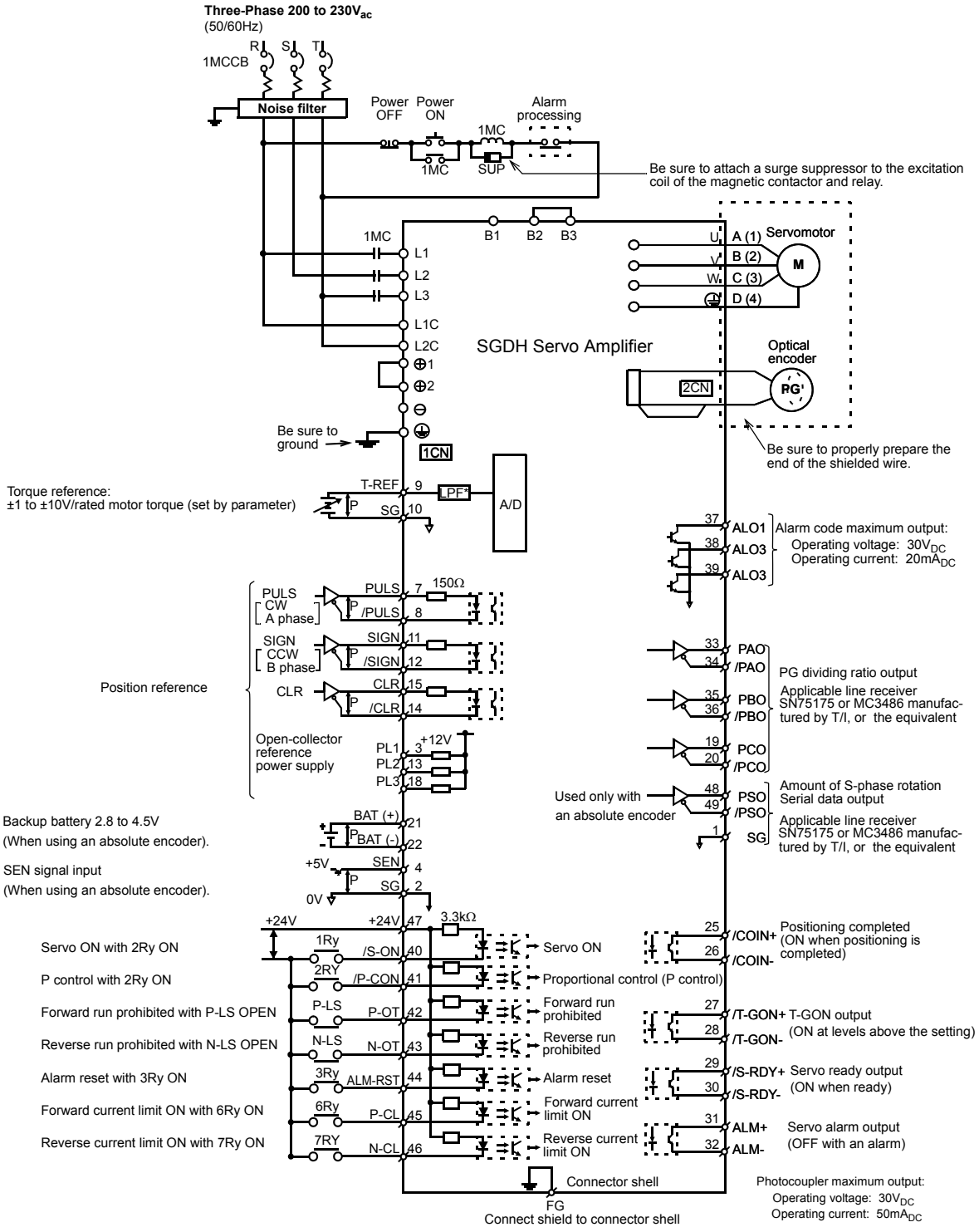
P: Indicates twisted wire pairs.

Note: The thermal protector must be wired to provide protection in the event of the motor overheating.

400V (37kW to 55kW)



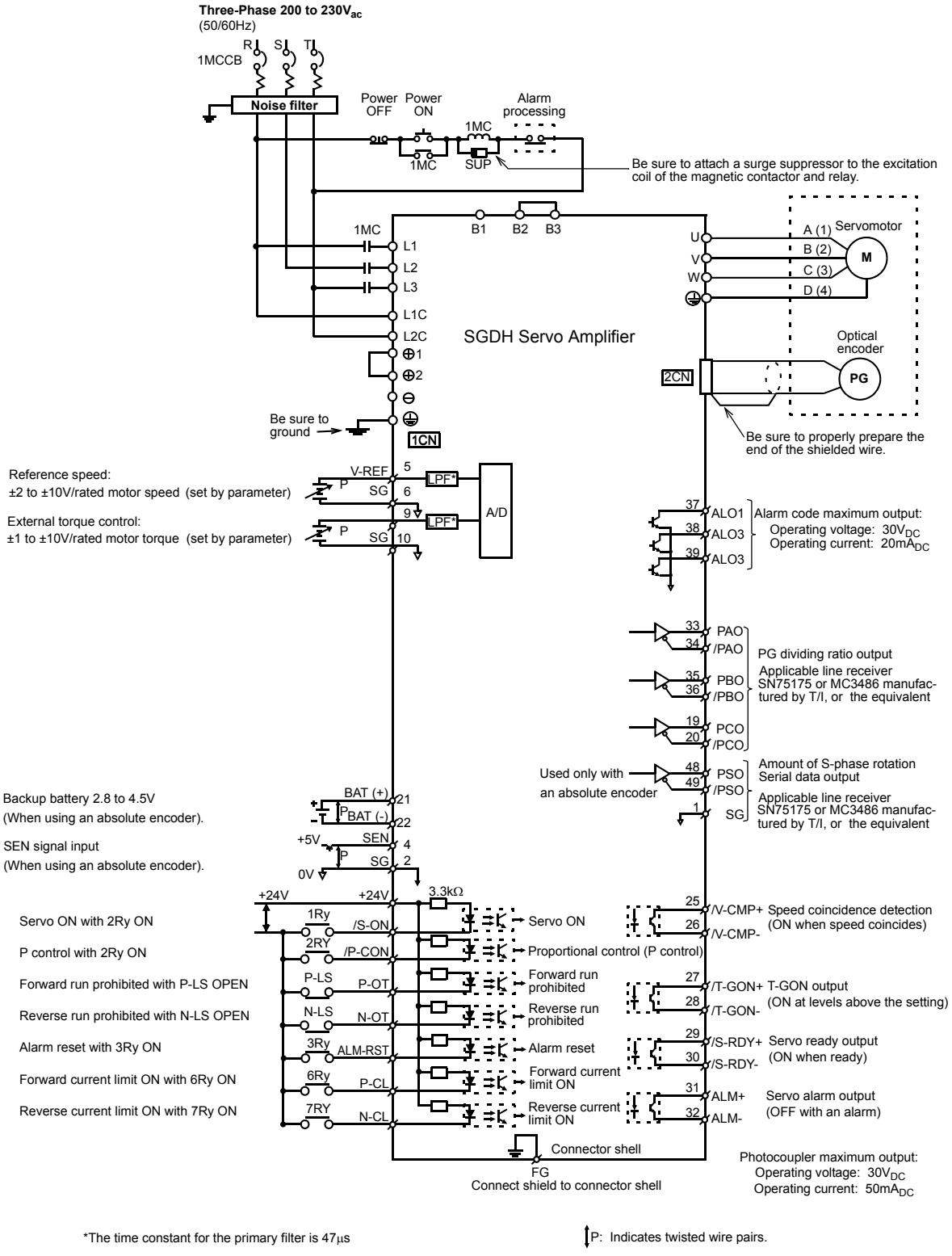
C.4 Position Control Mode



*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

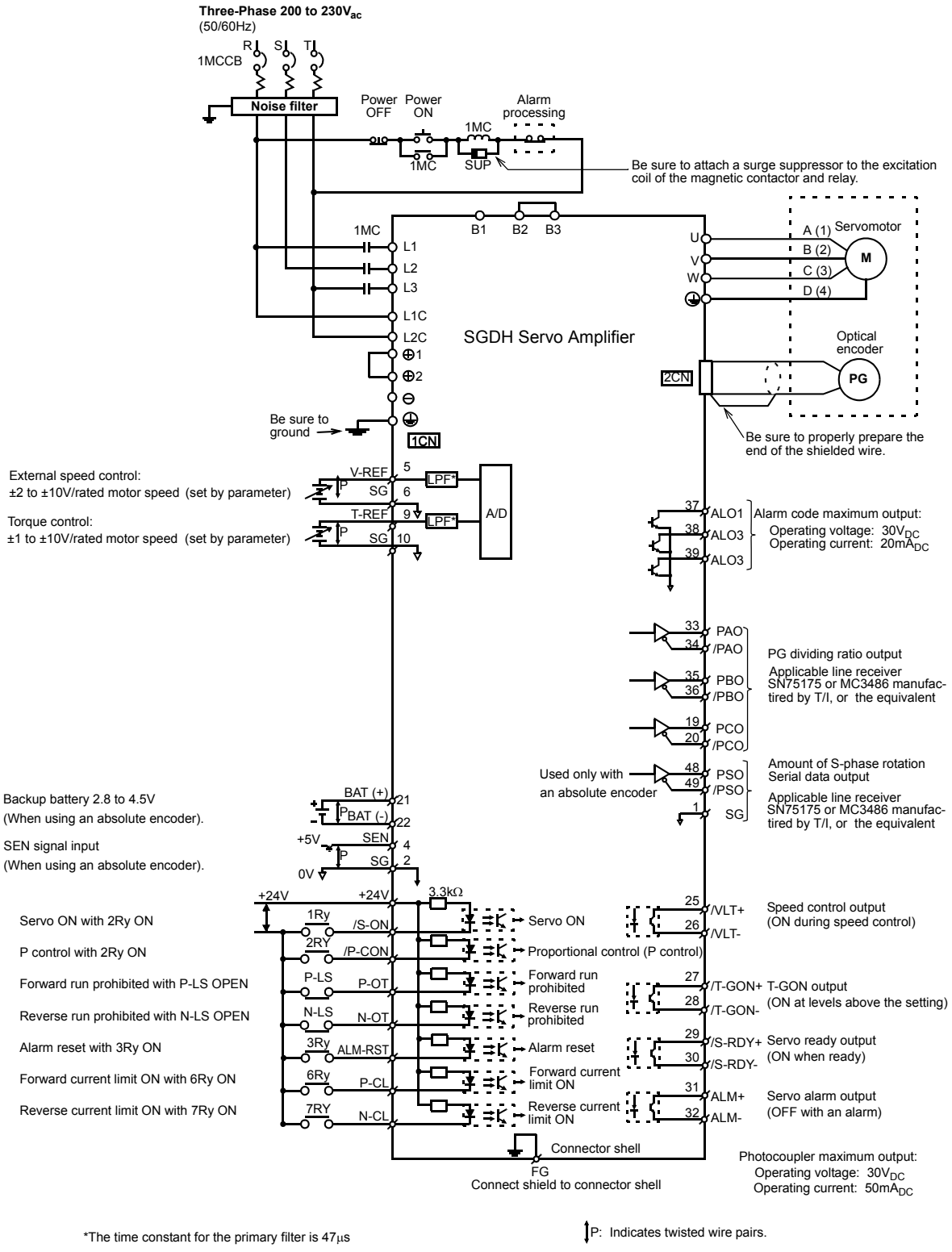
C.5 Speed Control Mode



*The time constant for the primary filter is 47μs

P: Indicates twisted wire pairs.

C.6 Torque Control Mode



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